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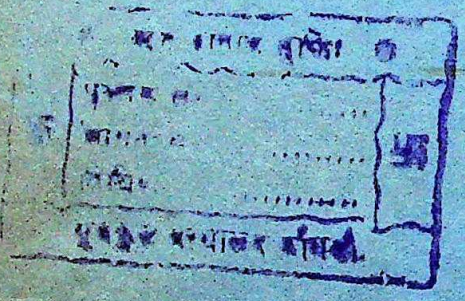

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THE GAME BIRDS OF THE INDIAN EMPIRE.

BY

E. C. Stuart Baker, C.I.E., F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

Vol. V.

THE WADERS AND OTHER SEMI-SPORTING BIRDS.

Part XX.

(*With a coloured plate*).

(*Continued from page* 306, *of Volume* xxxvi).

Genus: Philomachus.

Philomachus—Anon., Allg. Lit. Zeit, 1804, Col. 54.
Type by mon.—*Tringa pugnax* Linne.

This genus is distinguished from other genera of the family in having the male much larger than the female, whilst the former in the breeding season assumes a ruff of long feathers extending from the nape down each side of the neck and varying in colour to the most extraordinary degree. The Ruff is said to be polygamous and to fight and display for the females in a manner very like some of the Game-birds.

The bill is moderately long, straight and flexible, both mandibles grooved over the greater part of their length, the linear nostril being placed in the groove close to the base of the upper mandible; the wing is of the usual shape, long and pointed with the first primary longest; the inner secondaries are lengthened; tail rather short and rounded; the tarsus is longer than the bill from the gape and transversely shielded in front and behind; hind toe moderate, outer and middle toe connected by a web, that between the inner and middle toe obsolete; the tail-coverts are very long.

There is but one species which extends throughout Europe and Asia.

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PHILOMACHUS PUGNAX.

The Ruff and Reeve.

Tringa pugnax.—Linn., Syst. Nat., 10th ed., i, p. 148 (1758) (Sweden).

Pavoncella pugnax.—Blanf. & Oates, iv, p. 268.

Philomachus pugnax.—Fauna B.I., Birds, 2nd. ed., vol. vi p. 228.

Vernacular names.—Geh-wala (Hind.).

Description—Winter plumage.—Forehead, feathers round the eye, cheeks and chin whitish, more or less suffused with buff; lores speckled brown and buff; upper parts brown, the feathers of the crown, scapulars and inner secondaries with visible dark brown centres and bands, concealed on the hind neck and upper back; tail brown with pale edges to the tip; wing-coverts like the back; the greater with broad white edges, primary coverts black with white edges; primaries brownish-black with white shafts; outer secondaries brown with white edges and tips; lower plumage and axillaries white, the throat, fore-neck and breast suffused with brown or buff.

Colours of soft parts.—Iris brown; bill dark brown, more yellow and paler at the base; legs and feet fleshy-yellow to horny-brown in adults; grey, olive-grey or plumbeous in the young.

Measurements.—Wing, ♂ 173 to 190 mm., ♀ 150 to 166 mm.; tail, ♂ 78 to 89 mm., ♀ 64 to 70 mm.; tarsus, ♂ 46 to 50 mm., ♀ 41 to 44 mm.; culmen, ♂ 30 to 36 mm., ♀ 29 to 31 mm.

In Summer both sexes have the upper parts blackish, the feathers edged with buff or rufous, whilst the breast, flanks etc. are much more suffused with brown.

The male at this season has the face covered with yellow carbuncles and grows an enormous ruff which extends from the nape to cover the entire breast. This ruff may be of any colour, chestnut, buff, white, black or grey; sometimes it is immaculate but most often it is closely barred or streaked with blackish; whatever may be the dominating colour of the ruff, it extends to the mantle and scapulars and, less often, to the inner secondaries as well as to the sides of the breast and flanks.

Young birds resemble the female in Summer but are duller and less barred and marked with blackish; the underparts are more strongly sullied with brownish-isabelline.

Distribution.—Ruffs and Reeves are found over the whole of Northern Europe and Asia, breeding as far South as Denmark and Holland—in former days in England—also in Esthonia and Central Russia. Its limits south during the breeding season in Siberia have not been defined. In Winter it occurs in Africa and Southern Asia. Within our own limits it has been found in the extreme north and the extreme south and in Ceylon. By preference the Ruff is a bird of coastal marshes and therefore its occurrences inland are not very numerous but there are not many places in India where it has not been met with, provided there is suitable country.

Nidification.—There are few birds whose nidification and domestic arrangements are more interesting than those of the Ruff and

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the Reeve. For breeding purposes they undoubtedly prefer wide expanses of marshlands not very far from the sea or on the shores of great lakes, such as occur in vast numbers in Finland and Lapland. When the breeding season commences the Ruffs and Reeves are still in combined flocks and the two sexes continue together until egg laying has actually begun. In the southern portions of their breeding range nesting commences in May and I have even heard of eggs laid in the last week of April. As one works further North nesting operations do not commence until the middle or end of May, whilst in the far North few eggs are laid before June. After the eggs are laid the Ruffs keep together in parties but the Reeves no longer consort together. Both before and after breeding commences Ruffs indulge in very wonderful displays and in much mock fighting. These displays may be carried out on any small piece of ground rising above the surrounding marsh, but even when the site is selected on an expanse of fairly dry land, the dancing nearly always takes place on the highest portion of it. Attendance at these showing-off places does not seem to be carried out according to any particular rule. Flights of three or four Ruffs arrive on the empty ground and after perhaps casually pecking round for a short time, suddenly start dancing. Sometimes a Ruff will run a few paces forward entirely by himself, then stop, spread his ruff and begin prancing about. At other times two birds will perform the same manoeuvres, eventually facing one another, where they stand, ruffs widely distended and heads held close to the ground. After a second or two in this position, each bird will jump into the air and pretend to tackle the other but I have never seen fighting take place in earnest. After a few minutes, the first flock may be joined by a second and so on for some hours; birds come and go, by no means always leaving with the same flock as that with which they arrived. When spending my holidays in Lapland I have sometimes stayed at a small farmhouse from which I was able to watch the Ruff's dancing-ground not thirty yards away from my window. So long as one kept quiet the birds seemed to be oblivious to one's presence, whether standing inside or outside the house, and they seemed to be equally little affected by the weather, for I have seen them performing all their evolutions with the same zest during driving snow and bitter east wind and in the midnight sun that shone warm and comforting. I have spent many a pleasant hour watching the birds from the above farmhouse and my watching has made me wonder whether the reputation acquired by the Ruffs for being polygamous and by the Reeves for being polyandrous is really deserved. In the first place the showing-off and so-called fighting among the Ruffs took place quite independently of whether any Reeves were present or not, nor did the fighting increase in bitterness when a Reeve, or Reeves, appeared on the scene. If two males were engaged in a *pas a deux*, perhaps one would stop and go and join the Reeve, when the other would continue his posturing and take absolutely no interest whatsoever in the departing Ruff and his mate. Again, I have sometimes, especially during the very early hours of the

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morning—between one and four o'clock—watched a Ruff and a Reeve continue in company the whole of this time and on one occasion I was within sight of three pairs, each wandering about entirely on its own. I myself came to the conclusion that the Ruffs, who took extraordinarily little interest in nest, eggs, or young, amused themselves at their 'clubs' while their wives carried on their domestic duties and, if one of the latter wished to interview her husband, she merely sought him out at one of his 'clubs', where he promptly joined her without any unpleasant remarks being made by his clubmates.

The extraordinary variation in the plumage of the Ruffs fortunately makes the identification of individual birds a very easy matter, and day after day we would see the same little group or groups of birds perform in exactly the same spot or spots. The opinion I formed after many visits to Lapland and much careful watching of the birds, was that Ruffs and Reeves pair just like other birds and, however neglectful a husband, the Ruff, may be, neither he nor his wife deserve the reputation they now possess.

Reeves breed in practically any kind of marshland and sometimes in almost dry pasture or sandy grassland. I have found their nests in the middle of extensive swamps, knee-deep almost everywhere in mud, with intervening spaces of much greater depth. I have taken others in places where one might wander miles without getting into mud over one's ankles and I have also occasionally taken them on the breeding grounds of Temminck's Stint, stretches of perfectly dry ground with alternating patches of short soft grass and bare gravelly patches. One very favourite swamp in the South of Lapland consists for the most part of black quivering mud of unknown depth, relieved here and there by little patches of rather thicker mud where tussocks of grass enabled one to walk in comparative safety. The one year in which I worked this place and before experience had taught me its danger, we found many nests of the Reeve in these same tussocks of grass, but one year's experience of this particular swamp satisfied all my ambitions and I have since left it undisturbed.

The nest of the Reeve, wherever it may be placed, is nearly always well hidden and, though it is such a common bird and one feels that one *ought* to find nests by the dozen, one's expectations are never realised. Once the eggs are on the point of hatching the hen bird sits very closely but she is so clever that when she does leave the nest, she gives little clue to where that may be. As a rule when one is still 20 or 30 paces away she comes off her eggs and, head and tail held low down, sneaks quietly away through the cover. When she thinks she has got far enough away from it she stands upright and in the most unconcerned way possible begins to peck insects off the grass all round her. As her disturber approaches, she wanders away slowly in front, taking a zigzag course, but one which all the time leads her away from the nest. So anxious, however, is she to get one away that she will frequently allow approach within two or three paces of her and on one occasion I actually dropped my cap over her as she stood in apparent unconcern a couple of yards in front of me.

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Eventually we found that the easiest way to find the nest was to place a stick in the ground at the spot where we had first seen her and at the place where we were standing when we first caught sight of her. A beat round between these two spots sometimes revealed the nest. Of course when the birds are sitting close after incubation has begun one may, especially if it is a windy, rainy day, get quite close to them by walking against the wind and rain and I have sometimes found two or three nests in a morning in this way. The birds do not always, or even generally I think, make their nests close to where the cock birds have their dance grounds. I remember one stretch of swamp where there were three or four such places, and General Betham, a Swedish friend, and I worked the whole area out most carefully but we only found five Reeves' nests in the course of three days' search, although there were at least fifty Ruffs showing off on the various mounds and at least fifty Reeves visiting the place from time to time. Indeed we noticed here that very often after the Reeves had been to one of the 'clubs' they would fly away entirely out of sight, obviously to some other swamp a good distance off. Nor do all the Reeves, as has often been suggested, of any one particular area, breed in company and I have never found more than three, or at the utmost four, nests in close proximity to one another.

The nest itself is a very primitive affair, but whether placed in swamp or in dry ground, it is always above the wet and, wherever necessary, sufficiently lined with fine grass or by the surrounding grass being beaten down to keep it snug and warm. The grass over the nest is never arranged in the curious little twist beloved both by the Common and Dusky Redshanks but, at the same time, it is seldom easy to spot. The eggs are normally four in number though three only are occasionally laid. When I wrote the *Fauna of India* I was under the impression that threes and fours were almost equally common but my personal experience of the last few years has shown me that threes are really exceptional, and that four is really normal, just as it is with other waders. As a series the eggs of the Reeve do not vary very much. In nine clutches out of ten, the ground colour is some shade of buffy brown, heavily blotched and spotted, especially at the larger end, with dark brown, or blackish brown and a certain number of secondary blotches of pale lavender or inky grey underlying. As a rule the markings are large, bold and clean cut but in others they are somewhat smudgy. In nearly all eggs the markings are most numerous at the larger end, where they occasionally form a cap but never rings. In some eggs the ground colour is tinged with yellowish and in others it is distinctly greenish. Occasionally a clutch may be met with with a pale grey stone ground. I have one clutch of this latter, heavily marked with deep blackish brown and with numerous secondary marks in addition, which but for their size, are exactly like the eggs of the Greenshank. Occasionally also eggs may be found which are very hard to distinguish from those of the Great Snipe. In shape the eggs are generally rather broad ovals and

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distinctly pointed at the smaller end. Other eggs are somewhat longer ovals in shape while occasionally one meets with very short stumpy ovals.

Jourdain gives the average of 141 eggs as 43.9 × 30.7 mm.; maxima *47.5* mm. × 30.5 mm. and 43.2 mm. × *32.1* mm.; minima *39.8* mm. × 31.6 mm. and 42.9 mm. × *28.0* mm.

Habits.—Ruffs and Reeves, all in winter dress, arrive in India in some numbers during September and are in full force by the middle of October, whilst a few small flocks arrive in the North of India, especially in the North-West, in the end of August. They leave us again for their breeding haunts in April, by which time a few of the males are beginning to assume summer plumage. Ticehurst remarks that he has never seen or heard of a bird being obtained in India with a ruff, but such birds have been shot on several occasions. Messrs. Mundy and Moore say they once shot Ruffs in the Dibrugarh district which were beginning to assume the ruff and I myself obtained one such specimen on the 2nd of May, an individual out of a small flock of about a dozen birds on their migration to the North. The individual shot was the only one in the flock which had begun to acquire the ruff. As a rule the males before they leave us have acquired a certain amount of brown on the breast and flanks as well as the blackish upper parts. It is curious that birds seem to stay later in India in the North-East than they do in the North-West, for Ticehurst says that the latest date he has seen them in Sind is the 2nd of April, whereas, as already noted, in Assam I have seen birds exactly one month later than this and have frequently seen others in the middle and third week of April.

Ruffs and Reeves are very gregarious birds and one seldom sees flocks of less than half a dozen or a dozen, though nearly all the other waders may be met with singly or in pairs. Sometimes one sees in winter small flocks consisting entirely of males or females but as a rule the two sexes are found together in about the same numbers. Sometimes the flocks are very large and on one occasion I saw one which must have numbered at least 200 and possibly a great many more. In their winter haunts they are not at all wild and generally allow a fairly close approach, though flocks coming into India or leaving it seem to be much wilder than those which have settled down. With us they seem to prefer the bigger swamps and marshes, especially those which are on or near the coast, but I have seen them on sandbanks in and beside rivers and, stranger still, once or twice on the shingly shores of streams debouching from the Himalayas; probably in the latter cases the birds were merely resting on migration to and from India.

Like most of the waders and indeed with like most other migratory birds as well, the Ruffs and Reeves when entering North-East India seem to fly from one great mountain ridge to another rather than, as is so generally supposed, following the course of some great river. I have twice noted seeing Ruffs and Reeves on grasslands of the Barail Range at about 4,000 feet. On both occasions the birds merely pitched into the grass for a very short

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period and then passed on South. When shooting on the North bank of the Brahmapootra we of course often saw these birds in the swamps but when we worked up rivers such as the Subansiri, Dibong, or Dihong, well into the hills, we never met with them.

Ruffs and Reeves have a strong powerful flight, more direct and less wheeling than that of most waders, but at the same time they offer quite sporting shots and, as when shot they provide quite a dainty dish, they are certainly entitled to be ranked as semi-sporting birds. The only call we are likely to hear in India uttered by this bird is a low 'chuck, chuck' as they alight or as they take to wing.

Their food consists of all insects, small mollusca, tiny frogs and reptiles and also of many kinds of berries, seeds, rice and other grain. When they arrive in India they are sometimes, but by no means always, in poor condition, but a very few days serve to fatten them and when shot in December, January and February, they are often regular balls of fat.

Sub-family: *Eroliinae*.

In this sub-family are contained those genera in which the anterior toes are divided to the base. In one genus there is no hind toe but in the others this is well developed. The wing is shaped as in the *Tringinae*, with the first primary the longest; the bill is slender, flexible and either quite straight or slightly bending downwards; the tail is moderate and almost square, some species having the median rectrices slightly acuminated and projecting beyond the others, for which they, in consequence, have been placed in a separate genus by some authors.

A. No hind toe ... *Crocethia*, p. 231.
B. A hind toe
  a. Bill spoon-shaped, greatly expanded at the tip ... ... *Eurynorhynchus*, p. 232.
  b. Bill slender, not spoon-shaped ... *Erolia*, p. 233

Genus: Crocethia.

Crocethia Billberg.—Synops., Faun. Scand., i (2), tab. A, p. 132 (1828).

Type by mon.—*Tringa alba* Vroeg.

This genus, which contains but one species, the Sanderling, is very close to *Erolia* but is separated from that genus by possessing a hind toe; the bill and tarsus are about equal in length.

Crocethia alba.

The Sanderling.

Trynga alba Pallas, Vroeg's Cat. Coll. Adum., p. 7 (1764, (Holland).

Calidris arenaria Blanf. & Oates, iv. p. 279.

Crocethia alba, Fauna of British India, Birds, 2nd. ed., vol. vi., p. 231.

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Vernacular names.—None recorded.

Description.—Breeding plumage.—Upper parts rufous, each feather with a broad black centre and narrow white fringes; lateral rump-feathers and upper tail-coverts white; primaries black with white shafts and with pale inner webs becoming white, this extending to the outer webs on the innermost primaries; outer secondaries grey with white edges; greater coverts brown with broad white tips; inner coverts like the back; chin, throat, foreneck and upper breast rufous, spotted with black; remaining under plumage, axillaries and under wing-coverts white, the rufous with black spots sometimes extending down the flanks.

Colours of soft parts.—Iris dark brown; bill black; legs and feet dusky-grey or brown to black.

Measurements.—Wing 118 to 129 mm.; tail 52 to 62 mm.; tarsus 23 to 26 mm. (once 21 mm. only); culmen about 21 to 26 mm., once 28 mm.

In Winter the upper plumage is black with broad white edges, giving the impression of greyness; the hind-neck is generally grey, the dark centres obsolete; forehead and face white, but generally some rufous and black markings on the lores; lower back, rump and upper tail-coverts grey, the back and rump with tiny black bars, the coverts with pale whitish tips and blackish sub-tips merging into the grey of the base; wing-coverts and inner-most secondaries like the back; quills as in the Summer plumage; lower plumage all white.

Nestling.—Upper parts stippled with light and dark buff and black with tiny specks of white; forehead buff with a black line from the base of the upper mandible to the crown, two black lines above and below the lores to the eye. Under-parts white, cheeks, chin and throat tinged with buff.

Distribution.—The Sanderling is one of the most northern of our waders during the breeding season, being found in Spitzbergen and the extreme North of Russia and Siberia. It also extends to Greenland and Alaska and has been reported—probably by mistake—as breeding in Iceland. In Winter it is practically circumpolar being found in Africa, practically the whole of Southern Asia, Australia, Chile and Patagonia. In India it is a common bird down the West Coast as far as Malabar but on the East Coast and in Eastern India generally it is much less common, although every winter a certain number do occur. In Assam and Eastern Bengal I came across it yearly but never in any very great numbers.

Nidification.—The Sanderling is still one of the birds about whose nidification very little is really known. It has been found breeding in Spitzbergen, Taimyr, New Siberian Islands, Melville Islands, and Ellesmere Land and Greenland and again in Alaska. The bird is said generally to select rather barren stony places for breeding purposes though the nest itself is generally made where there is a little grass. It consists merely of a few blades of grass in a natural hollow, occasionally surrounding grass being bent down to make it rather more substantial. As might be expected in a bird breeding so far North, the season is very late, few birds

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commencing to lay before the end of June, while more lay about the middle of July. The number of eggs laid is of course four as with all waders. In Witherby's *Practical Handbook* Jourdain describes the eggs as follows:—

'Ground colour pale greenish when fresh, fading to buffish or ochreous, and sparsely marked with small brown spots and ashy shell-marks, with occasionally a blackish streak or a spot or two at the larger end.'

Average of 41 eggs:—35.7 × 24.7 mm.; maxima *38.2* × 24.7 mm. and 34.1 × *26.1* mm.; minima *33.1* × 24.4 mm. and 35.3 × *23.5* mm.

Both Fielden and Walter shot male birds off the nest, so there is no doubt that both sexes participate in the duties of incubation. During the breeding season they are said to be fairly tame and to allow of a close approach when sitting. Dr. Hortling and I saw this bird in full breeding plumage at Pumanki in the extreme North of Lapland on the 20th of June, but this is very far South of their usual breeding habitats, though nestlings were seen once on Bear Island.

Habits.—In India the Sanderling is comparatively common as a winter visitor but is much more numerous on the West than on the Eastern side. In the extreme South it has twice been obtained in Ceylon, but is extremely rare even so far South as Travancore. In its habits generally it differs very little from those other small waders that visit India but I do not think it is ever found in separate flocks. As a rule single birds or pairs are seen feeding on marsh lands or mud flats in company with other small waders and as these may happen to be wild or tame so will appear to be the Sanderling that are with them.

Their flight is exactly like that of the Green Sandpiper or Dunlin and is very fast but at the same time I do not think the Sanderling is one of the small birds which one could call semi-sporting. Its food consists of all kinds of small insects, tiny worms, mollusca and also seeds and certain water plants. In Europe it feeds largely on small crustacea and, according to Witherby, on bits of moss and algæ.

The Sanderling arrives in India the same time as our other small visitors. A few birds of the Western coast arrive in August but the majority not until late September, while on the Eastern side of India I do not remember ever seeing them before the end of that month.

Ticehurst has an interesting little paragraph on this bird in the *Ibis* of 1924, p. 118, where he writes:—

'Amongst the host of small waders which frequent the broad foreshore at low-water, the Sanderling can be recognized as far off as it can be seen by its ceaseless activity: it is running quickly, all the time incessantly picking at what it is searching for, leaving all other waders "standing". I fancy its food consists of small crustaceans brought in by each lap of the waves, but I also identified chrysalids of Diptera washed out of wrack. When the tide comes up to the full of the beach (here sand), all waders stop feeding and congregate in large flocks above high-water mark to await the tide's ebb, but the Sanderling feeds on after all the

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others, and only joins them for a brief space at dead high-water. It is remarkable how quick is digestion in waders: birds shot at high-water during the rest-period, which only extends over about an hour, have their stomachs already empty.'

Genus: Erolia.

Erolia Vieill., Anal. nouv. Orn., p. 55 (1816).

Type by mon.—*Erolia variegata* = *E. ferruginea* Brunnich.

In this genus the bill is flexible and slender, varying a good deal in length and either straight or slightly curving downwards; both mandibles are grooved and the small nostril is placed near the base; the tarsus is short and scutellated: there is a hind toe present and the anterior toes have no webs between them; the wing is long and pointed, the first primary longest; the tail is nearly square, with the centre feathers pointed and projecting beyond the others.

In the present work I retain in the genus *Erolia* all the species accepted by Blanford as belonging to *Tringa*, with the exception of the Knots, which are now generally accepted as belonging to a different genus, *Calidris* and the Broad-billed Stint, *Limicola*, by itself, a division which is also now universally accepted. This leaves seven species occurring within the limits of this work, whilst the genus, as a whole, may be said to be cosmopolitan.

Erolia minuta minuta.

The Little Stint.

Tringa minuta Leisler, Nacht. Bechst. Nat. Deutsch., p. 74 (1812) (Hanau); Blanf. & Oates, iv, p. 273.

Erolia minuta minuta.—Fauna of British India, Birds, 2nd. ed., vol. vi, p. 234.

Vernacular names.—*Chota Pan-loha* (Hind.).

Description.—Breeding plumage. Forehead and small supercilium, often obsolete, pale fawn; crown and mantle blackish, each feather with rufous edges to the sides and those of the mantle with white fringes; hind-neck paler and less broadly marked with black; lower back, rump, upper tail-coverts and central tail-feathers blackish with paler edges; sides of rump and lateral upper tail-coverts white; lateral tail-feathers pale grey-brown with whitish edges; wing-coverts grey-brown with darker centres and the greater with broad white tips; quills blackish with white shafts; the inner webs of the primaries and outermost secondaries paler and the central secondaries dark grey with white edges; under-plumage white, the breast suffused with rufous and speckled with black.

Colours of soft parts.—Iris brown; bill black; legs and feet olive-plumbeous or blackish-brown.

Measurements.—Wing 91 to 98 mm.; tail 38 to 43 mm.; tarsus about 20 to 21 mm.; culmen 17 to 19 mm.

In Winter the upper parts are grey-brown, the crown with broad black streaks, the hind-neck only faintly marked, the mantle with black shaft-streaks and the scapulars and secondaries edged

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with white; the greater coverts are grey-brown with broad white tips forming a wing-band; below the whole plumage is white, the breast sometimes faintly marked with brownish.

Young birds are like the adult in Summer with the whole under-parts white or nearly so, the hind-neck is more grey, less rufous, whilst the rufous on the mantle is less dominant.

Nestling.—Upper parts rufous, mottled with black, the nape more ochraceous-buff and the crown dark buff; a black median coronal line and a second black line from the lores through the eye; sides of the head, chin, throat and breast ochraceous, remaining under-parts white.

Distribution.—Northern Europe to Central Siberia, migrating South in Winter to Northern Africa, Palestine, Arabia, Mesopotamia, North-West and Western India to Ceylon; East it is more rare but extends to Bengal, Assam and Madras.

Nidification.—The Little Stint breeds from Northern Russia to Central North Siberia and regularly, but in small numbers, as far West as Finnish Lapland, where a nest has been occasionally taken by Finnish naturalists, and where I personally saw pairs during the breeding season, though I failed to find the nest. The birds are late breeders; over the greater part of their range they probably commence breeding about the 20th of June but at Kolguev Pearson found fresh eggs on July 14th, taking numerous nests during the greater part of that month and again equally numerous nests at Novya Zembla from the last week in June to the third week in July. Preferably the Little Stint breeds on marshes close to the sea and frequently on islands in it, but at the same time Pearson often found the nests on marshes far inland, and he also found them breeding in thick green moss in wet ground on the uplands. The nest is a very simple little affair, merely a small amount of grass twisted round and placed in hollows among dry grass in the marshes or, as already stated, in thick soft green moss on the highlands. The nest is generally fairly well concealed but the little bird sits so close that the nests are very easy to find, for she never leaves it until almost trodden on and even then remains in its immediate vicinity. Again and again Pearson remarks on the extraordinary tameness of this little wader. Frequently when the eggs were taken and Pearson and his brother sat down by the nest, the little bird would return and sit by it, within a few inches of them, looking up in their faces as if beseeching them to return the eggs, while at other times she would 'execute a little dance within a few inches of their feet'. Apparently the depressions in which the nests are placed are natural ones among the grass roots and not excavated by the birds themselves, while at other times the nest merely rests lightly at the bottom of a tuft.

A complete clutch of eggs is invariably four in number and they are in appearance typical little waders' eggs. The ground colour varies from pale grey, yellowish grey or stone colour, to a pale buff, while still more rarely it may be a pale blue green. The markings consist of small spots and blotches of various shades of brown and red brown, ranging from quite a pale sienna brown

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to a rich purple or blackish brown. These are distributed fairly numerously over the whole egg but are always more plentiful at the larger end. Under these primary markings are a certain number of lavender and blue grey of the same size, which are distributed in the same manner but are never very prominent. In some eggs the spots are all replaced by larger blotches, such eggs being very handsome.

Jourdain gives the average of 100 eggs as 28.8 × 20.7 mm.; maxima 31.7 × 20.3 mm. and 30.0 × 21.4 mm.; minima 26.7 × 20.0 mm. and 28.7 × 19.6 mm.

In shape the eggs are the usual pegtop or pointed ovals and in texture they are hard, close and fairly fine, sometimes showing a slight but distinct gloss. The male bird does nearly all the incubation but sometimes, at all events, the female also sits on the eggs, for both Pearson and Harvie Brown caught female birds on the nest. Incubation, according to the Finns, takes 16 days.

Habits.—This little wader arrives in India early in August, the first few birds turning up in the second week in that month; while the full flood arrives in September. I have noticed that the first few birds to arrive in this country are always females and Ticehurst remarks that the adults of nearly all waders arrive in Sind during the first days of August, while the young of the year do not arrive till three or four weeks later. Ticehurst also reports that in Karachi Harbour the Little Stint arrives with great punctuality during the last days of July. In India it is an inland swamp bird almost to the same extent as it is a bird of swamps near the sea. I have noticed it in immense numbers in Assam and even in Western Bengal but, apparently, in Central India it is a comparatively rare bird. It is generally found either singly, in pairs, or in quite small parties, though it consorts regularly with other waders with which it feeds in company. It is an active restless little bird except during the extreme heat of the day, when they may be seen resting on one leg with their head well tucked in between the shoulders. Their actions when running about and also their flight are very similar to those of other small waders, but the speed with which they rise from the ground, twisting rapidly the first few yards, is very noticeable. Their breeding display is similar to that of Temminck's Stint described further on. Their food consists of small coleoptera, mollusca and insects of all kinds and occasionally seeds and buds of marsh plants.

Erolia temminckii.

Temminck's Stint.

Tringa temminckii Leisler, Nacht. Bechst. Nat. Deutsch., p. 63 (1912) (Hanau); Blanf. & Oates, iv, p. 275.

Erolia temminckii.—Fauna of British India, Birds, 2nd. ed., vol. vi, p. 237.

Vernacular names.—None recorded.

Description.—Breeding plumage.—Upper plumage black, the feathers of the crown edged with rufous, those of the back etc. barred and tipped with rufous; lower back and rump blackish;

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central tail-coverts blackish, finely edged and tipped with rufous and sometimes notched with the same; lateral tail-coverts white; inner wing-coverts and inner secondaries like the back; median coverts brown edged with grey; greater coverts darker brown, broadly edged with white; primary coverts and primaries black, the first primary with a white shaft, the inner primaries with a white patch at the base of the inner webs; outer secondaries brown with white bases and edges; sides of the head and neck fulvous-white streaked with dark brown; chin and throat fulvous-white, very lightly streaked; breast a darker fulvous streaked with black and with indefinite bars on the lower breast and anterior flanks; axillaries and lower plumage white; central tail-feathers brown; outer white.

Colours of soft parts.—Iris brown; bill black; legs and feet olive-green or yellowish-olive.

Measurements.—Wing 90 to 100 mm.; tail 45 to 48 mm.; tarsus about 16 to 19 mm.; culmen 15 to 17 mm.

In Winter the upper plumage is light grey-brown, each feather with paler grey edges and a dark shaft-streak; head and neck paler and more grey, the shaft-streaks obsolete; forehead and supercilium white; sides of the head pale grey; chin and throat white; foreneck, sides of neck and extreme upper breast pale brownish-grey, the centres of the feathers darker; remainder of underplumage white.

Nestling like that of the Little Stint but paler, more yellowish-buff and less cinnamon or rufous.

Distribution.—Breeding from Scandinavia to North-East Siberia. In Winter South to North Africa and Southern Asia. In India found all over the North in great numbers, becoming less common in the South and rare in Ceylon. It is common some Winters in Assam and Bengal but much less common in Burma, though it is found as far South as Tenasserim.

Nidification.—The nidification of Temminck's Stint is very similar to that of the Little Stint but, although many nests of the latter bird may be found fairly close together, it can hardly be said to breed in colonies, whereas I have found 12 or 15 nests of Temminck's Stint within an area of about half a square mile. Like the Little Stint, they are late breeders and very few nests with their full complement of eggs will be found before the second week in June and far more in the last week of that month. I have found them breeding on islands in the north of the Baltic in great numbers but, in several years, no eggs were laid until the end of June, while even in warm years I found none before the 15th of that month. On the other hand at Pumanki in extreme Northern Lapland the birds all seem to have finished laying —in 1933—before the last week in June, and we found hard-set eggs on the 13th of that month. Undoubtedly Temminck's Stint prefers to breed in great stretches of short grass lands near the sea but many couples breed far away on the inland pasture lands where the country is to some extent drained and the deep swamp is replaced by the very wet muddy pasture-land on which the Finnish cattle are turned out in July and August. Here how-

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ever I never met with any colonies, generally only single pairs were found and never more than two or three. The nests are like those of the Little Stint, just neat little cups composed of a small amount of grass wedged in amongst the roots of the growing grass. The birds seem always to prefer cover which is quite short, generally a few inches high only, and no great attempt seems to be made at concealment. On the other hand the birds do not sit nearly as closely as does the Little Stint and the nests therefore take more finding; at the same time they are not really wild, generally getting up from their nests when one is ten or twenty paces away and often returning immediately one's back is turned, while, once the eggs are very hard-set, they will occasionally sit until almost touched.

The eggs of course number four as usual and cannot, in my opinion, be distinguished from those of the preceding bird. At the same time, as a series they are not so large and the blotches are not so big, nor are the eggs as a whole quite so richly coloured. With these exceptions the description given for the eggs of *minuta* would do equally well for *temminckii*.

Jourdain gives the average of 100 eggs as 27.9 × 20.4 mm., maxima *30.5* × 20.8 mm.; and 28.8 × *21.5*; minima *25.5* × 20.8 and 28.2 × *19.4* mm.

The breeding display of this little bird is very charming. When one first arrives on the breeding ground where there are several pairs of birds nesting, one hears overhead and on all sides of one a most beautiful little trilling note continued for some seconds and, on looking up, one sees what appears to be a large butterfly. This, on a closer look, proves to be this tiny wader, its head held high up and wings beating the air with incredible rapidity as it hovers and sings; then, still singing, it descends in wide curves to some rock or other point of vantage near its nest, where it again utters its beautiful note. Undoubtedly the hen bird sometimes trills and displays for, from the first nest I ever found, I put up first one bird which rose trilling into the air and, while he or she was so engaged, the other bird returned to the nest and when I put that up, he or she did exactly the same. The greater part of incubation is carried on undoubtedly by the male but the female takes a share in it, sitting while the male is away feeding. We noticed that the birds sang and performed to a greater or less extent throughout the whole day and as in most cases the bird we put off the nest was the male, I think many females must have been in the air trilling.

Habits.—There is really nothing one can say about the habits of this little wader in addition to what has already been said about the habits of the Little Stint. They arrive at the same time and depart at the same time, i.e. in April and the first week in May and they are found in the same kinds of places and in company with the same kinds of other birds. Food, flight and actions are also precisely similar.

(To be continued).

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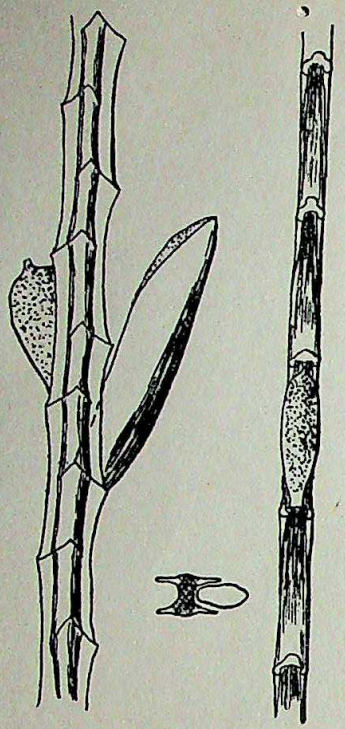
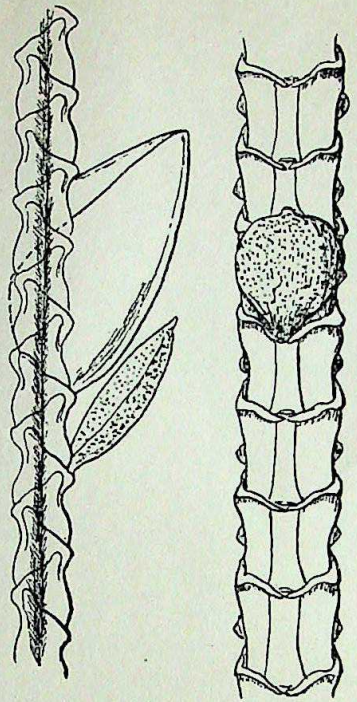
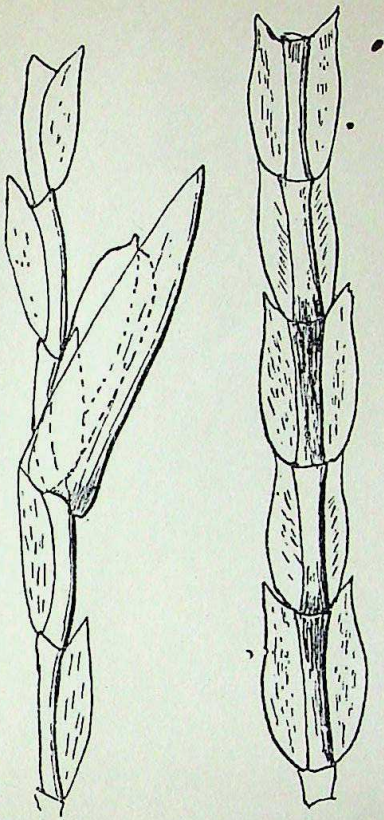


Del. C. McCann.
Rhachilla in the genus *Pycreus*.



Rhachilla in the genus *Juncellus*.



Rhachilla in the genus *Cyperus*.

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REVISION OF THE FLORA OF THE BOMBAY PRESIDENCY.

BY

E. BLATTER, S.J., Ph.D., F.L.S.

PART XXIII.

(*Continued from page* 795 *of volume* XXXVI).

CYPERACEAE.

BY

E. BLATTER, S.J., Ph.D., F.L.S. and C. MCCANN, F.L.S.

(*With* 3 *plates*).

CYPERACEAE (Cke. ii, 851).

MORPHOLOGY.

Seedlings: Little work appears to have been done on the seedlings of this order. Most of the seeds are shed at mid-monsoon or after, with the exception of those species that mature early. At this early stage *Cyperaceae* often are hardly recognizable from grasses, and are consequently overlooked. Some species have leaves only at this early stage, and these are lost later on. The seedlings of *Scirpus articulatus* Linn., for example, produce at this period leaves which are strap-shaped. In this state the plant does not look at all like one of the *Cyperaceae*. Soon after the appearance of the flowering culms and the drop in the level of the water, these leaves are shed, and the culms alone remain. As the collecting is mostly done soon after the monsoon, it is but natural that the specimens thus far collected are devoid of leaves. And this also accounts for the fact that the description records—leaves 0. The seedlings of *Cyperus corymbosus* Rottb. are another instance in point. Long leaves are developed in the seedlings of this species, while in old specimens the leaves are mere vestiges, sheaths alone encircling the culms.

We are of opinion that no *Cyperaceae* are ever devoid of leaves as described in the Floras; leaves at least develop in the seedling, though they may be shed sooner or later.

Rhizomes: *Cyperaceae* may be divided into two classes: (1) Those which die down completely after reaching maturity, in one short season. These have fibrous roots in all cases. (2) Those with an underground rhizome which throws up culms during the period of vegetation, or as long as the supply of moisture lasts, and then dies down above the surface of the soil and remains dormant till the next favourable opportunity. We refrain from using the terms 'annual', 'biennial', 'perennial', etc., as they certainly do not appear to be correct in their application in many of the species. The term 'annual' may be suitable to those with fibrous roots, but the other terms do not rightly describe the species with rhizomatic underground stems. The rhizomes in the same species may be very short with short nodes and the culms appearing caespitose, or they may be long, developing into creeping rhizomes with elongate joints and distant solitary culms.

Unless the complete plant is represented in the herbarium, it is next to impossible to distinguish the 'annuals' from the 'perennials'. Plants belonging to the first division have all fibrous roots, and do not call for any further comment here. Good examples are *Cyperus compressus* Linn., and *Pycreus pumilus* Dom. Many of these 'annual' species bud off at the base, but do not give rise to rhizomes or stolons. This process of budding is frequently responsible for tufted stems.

In *Cyperus corymbosus* Rottb. a thick long blackish rhizome is developed which gives off culms at intervals. The distance varies with the nature of the soil. The terminal anterior end of the rhizome at first produces a tuft of

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leaves (3-4) and from between these there appears the culm; when growth has proceeded so far, another growing point is developed which carries on the development of the rhizome. In *Scirpus littoralis* Schrad. the rhizomes are thin and long in appearance, like a stolon (Clarke does not seem to distinguish between a rhizome and a stolon). This type of growth often makes the plant appear as though it were planted in straight rows. In *Cyperus rotundus* Linn. the rhizome is ovoid (perhaps better referred to as a tuber) and thin wiry stolons are developed, connecting one tuber with the other. Tubers are developed at the extremities of each stolon. In *Mariscus paniceus* Vahl, the rhizomes are short and hard, in fact woody. In *M. konkanensis* Sedgwick, we have short hard rhizomes which give off numerous ovoid or subspherical tubers from the apex of which new individuals arise. As these tubers are frequently in a dense mass the stems appear as though they were densely tufted.

Rhizomes are generally covered with black-brown scarious scales, but we are inclined to believe that in some cases these scales are the remains of sheaths which split with the development of the rhizome and thus appear like scales. In fresh specimens of *Cyperus pilosus* we have found bluish purple lanceolate scales attached to the nodes of the rhizome. In *Cyperus bulbosus* Vahl, these scales form a very distinctive character and, when they are present in the specimens, this species cannot be confounded with *C. rotundus* Linn. with which it is often confused.

The rhizome certainly forms a very useful character in determinating species, but is not a reliable guide in all cases.

Clarke, in his excellent paper 'On the Indian species of Cyperus', makes the following statement: 'The whole of the *Exaltati* (in which I include the *Papyri*) are without stolons.' This, to our knowledge, is not correct, as we have found thick, hard, black rhizomes in *Cyperus exaltatus*. They are such large plants that they are rarely collected complete, and this may account for Clarke's opinion that they are devoid of rhizomes. If these plants are extracted from the ground without digging the stems generally come away with only a tuft of roots.

The roots of *Cyperaceae* vary much in the same species depending on the locality in which they grow. Thus in *Juncellus pygmaeus* we have observed the roots to be thick and spongy in soft waterlogged soil, while on drier sandy soil we have found them to be thin and very short. In the former case the size of the plant is small, while in the latter it is large.

Culms: The culm may be erect, decumbent, prostrate, or semi-scandent as in some of the forest-inhabiting *Scleria* in which the culms frequently reach a considerable length and in consequence use their neighbours as a means of support. The culm may be solitary, tufted, or arranged at intervals along creeping rhizomes. It may be naked, as in some of the *Scirpus*, with the exception of the sheaths which clothe it for a short distance up; or it may be leafy as in some of the *Scleria*. It is never branched except in the region of the inflorescence as in the case of *Scleria* and *Carex*. The stoutness of the culm varies considerably, but it is never very thick.

The culm is generally trigonous; but in some species this character is modified till the culm appears terete, and even triquetrous. In some cases the modification is carried still further and the stem appears winged. Below, the culm is invariably round, and gradually the shape characteristic of the species makes itself apparent until the position just under the umbel is reached, where it is generally more accentuated, though the common form at this point is trigonous. In *Scirpus articulatus* Linn. the stem is terete, while in *Cyperus exaltatus* it is trigonous. Again in *Scirpus grossus* the stem is sharply triquetrous, while in *Cyperus flavidus* Retz. the culm appears fluted. The culms of most *Cyperaceae* are solid, but there are some that are hollow and septate; in both *Cyperus articulatus* and *Scirpus articulatus* we find the latter condition. For the most part the culm is glabrous, but there are some species in which the angles of the culms are distinctly scabrid, so much so that they present a sharp cutting edge. Some culms are striate (many that are not striate in the fresh state present this character in the herbarium), while others are quite smooth. In some cases the culm is 'highly polished' and shining, while in others it is

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dull and in the case of *Fimbristylis tetragona* R. Br. the stem is covered with a greyish powdery substance.

The character of the stem is fairly constant in the same species, but there are cases in which there is a distinct difference in the same plant, as noticed in *Pycreus globosus* All. The true character of the stem is more often than not lost in herbarium material.

Leaves: The leaves are generally narrowly linear and grasslike in appearance, canaliculate above and carinate below, but unlike those of the *Gramineae* they are devoid of a ligule. They may be longer or shorter than the culm, or entirely suppressed. In some cases they are basal, but in others they are cauline, some ascending from one-third to half way up to the culm and in others, like *Scleria*, nearly to the top. In rare cases they are short-lived, decay and fall away. In *Scirpus articulatus* Linn., the leaves are developed in the seedling, but are absent in the mature plant. In *S. littoralis* Schrad., long flaccid leaves are developed, but are shed at maturity with the drop in the level of the water in which they grow. In both these species the leaves are developed under the surface of the water. In *Cyperus corymbosus* Rottb. long leaves are developed by the seedlings, and in the same plant the rhizome sends forth leaves at its apex; after the appearance of the culm these leaves disappear, leaving sheaths surrounding the base of the culm.

The leaves are usually long and flaccid, but in some instances, as in *Remirea maritima*, they are short and stiff. In *Mariscus compactus* Druce they are long and stiff, being very thick. The leaves are generally glabrous, but in some cases they are scabrid as in *Mariscus compactus;* sometimes only the upper surface is so, in others both surfaces are affected, while in others again they are scabrid on the nerves. The midrib is usually canaliculate above and very prominent below. Many longitudinal nerves are developed in the leaves, certain of which are more prominent than others in some species. The length of the leaves is a very poor character for diagnostic purposes as it varies considerably in the same species or even specimen.

Sheaths: We think that the sheaths enclosing the base of the culm are not always the remains of the leaf-sheath or sheathing petiole, but are of much the same cataphyllous nature as in the *Araceae*. In *Scirpus articulatus*, for example, the leaves are only developed in the juvenile stage, and not in the mature plant; no appendages are developed at its extremity. In *Cyperus corymbosus* Rottb. the same type of sheath is developed, but unlike that of *Scirpus articulatus*. Sometimes long leaf-like appendages are developed, and the Floras have treated them as leaves. Though, morphologically speaking, they are perhaps derived from transformed leaves, we hardly think that they should be treated as such in those species presenting this particular type of sheath. It is only in those species which have a naked stem in the mature state that we find these cataphyllous structures.

In the case of *Scleria*, for example, the sheaths encircling the culm are undoubtedly the remains of the leaf-stalk. In this case, as growth proceeds, (in tall forest species) the leaves in the lower portion are shed leaving the sheath encircling the culm.

Bracts: Long or short bracts are present in most *Cyperaceae*, but there are many cases in which they are reduced to mere vestiges or are altogether suppressed. In appearance, texture, nervation, and scabrousness etc., the bracts invariably resemble the leaves. The bracts are in most species apparently umbellate, but are really always alternate. They are usually divaricate or erect-patent; but in some species the lowest one is nearly erect or in some cases appearing as if it were a continuation of the culm, and in these instances the umbel appears as though it were lateral, as in *Cyperus laevigatus*, and in some cases of the genus *Scirpus*. The bracts are best represented in the genus *Cyperus* and in *Scirpus grossus*.

The character of the bracts is useful in recognizing some of the species, but on the whole of little value particularly in respect to their length. From the axil of each bract springs a ray; the number of rays is never in excess of the bracts though this may appear so in some species when the bracts are suppressed. The lowest bract is usually the longest, and as we go higher the bracts diminish in size till they disappear. In the case of compound and further divided umbels, bracteoles are developed at almost every division of

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the ray till the base of the spikelet is reached, where there are generally one or two empty glumes. These bracteoles behave in much the same way as the bracts and diminish in size the higher they go.

Inflorescence: The inflorescence may be composed of solitary, fasciculate, paniculate, or spicate spikelets. In *Kyllingae* the inflorescence is reduced to a dense capitellum or head, and this is also the case in some species of *Cyperus* and *Mariscus*. In the majority of the larger *Cyperi* the inflorescence is umbellate, compound, decompound and so on, which makes them very difficult of description. In the genus *Carex* we frequently have a paniculate or spicate arrangement. The compact heads of the *Kyllingae* and the large compound inflorescence of the *Cyperi* appear to us to be the result of the contraction of the upper part of the culm. The rays of the inflorescence are much like the culm in character. Upon the rays are arranged its branches or the spikes, as the case may be. The ultimate unit of the inflorescence is the spikelet.

Spikelet: At the base of every spikelet there are usually present one or two empty glumes. It is hard to ascribe their true nature to these structures, but we are inclined to believe that they are the result of modified bracteoles, as, in some instances, they certainly appear to have originated from this source. The glumes that subtend each floret are arranged along a central axis, the rhachilla. The glumes appear to be not far removed from the lower empty glumes, though in most cases they differ in configuration. It appears that these glumes are nothing more than bracteoles and not true floral investments, and that the true floral investments are represented by the 'hypogynous bristles' that are to be found in some of the genera such as *Scirpus, Eleocharis*, etc., and may be regarded as a primitive character. Within each one of these glumes is to be found the floret, whether male or female. In this connection we are of opinion that the so-called spikelet is in reality a spike and the floret the ultimate division of the inflorescence.

The glumes are either distichously or spirally arranged along the rhachilla. The rhachilla varies considerably in shape and length, it may be winged or not. The wings are undoubtedly formed by the decurrent margins of the glumes, though this is not very noticeable unless very carefully examined. The *Cyperi* are most interesting in this respect. In *C. corymbosus* Rottb. the rhachilla is broadly winged by the decurrent margin of the glume. In some cases the colour of the wing is given as a diagnostic character; but this point certainly cannot be relied on, as we have noticed that in this particular species when the inflorescence is young the wings are hyaline and gradually become browner as it gets older; thus the colour depends very much on the age of the inflorescence. The wings of the rhachilla are within the glume, below the one from which it is the decurrent margin and embraces the nut.

The colour of the glumes like that of the wing of the rhachilla is a dangerous character and should be used with circumspection, particularly in herbarium material. The glumes may or may not be nerved, but when this character is present it forms an useful combination with the other characters of the species.

Stamens: There are usually 1-3 stamens. The number of stamens in the same species is usually a constant character, but occasionally there are exceptions to this rule. The filaments are flattened or ligulate, frequently becoming a little broader above. In some species the filaments persist for a long time after the glumes have fallen. In this case the anthers drop off.

Style: The style may be short or long, and may be either 2-fid or 3-fid; the branches are usually long and linear. The style proper, or the unbranched portion, is sometimes variable in character—trigonous, triquetrous, or almost winged. It may be glabrous or papillose.

Nut: The nut varies much in size, shape, and texture according to the species. It is generally 3-gonous in *Cyperus*, laterally compressed in *Pycreus*, dorsally compressed in *Juncellus*, cylindric in *Fimbristylis tetragona* R. Br. The surface may be smooth, puncticulate, tuberculate, reticulate, etc. The mature nut forms a very reliable means of determination if the shape is properly preserved in the herbarium; young nuts are very often misleading.

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The colour varies considerably with the age of the nut. Microscopical examination is essential, as determination of *Cyperaceae* from this character with a pocket lens or a very low power cannot be relied upon.

Fertilization.

Nothing of value has so far been observed with regard to pollination in this order. Muller, in his work on 'The Fertilization of Flowers', glosses over the subject with the remark that the flowers are anemophilous, and says that he has observed certain of the *Carices* visited by the hive-bee. The anthers are no doubt suited for this type of fertilization, though this is not the only one the order depends on. If we examine the fruiting spikelet of any of the *Cyperaceae* it will be noticed that all the florets have been fertilized and bear nuts. Wind pollination in itself would not be responsible for this fertility throughout. How then are we to account for this prolific fertilization? In our experience this is effected in the following manner: The lowermost floret in the spikelet develops first—here the anthers are matured before the stigmas. This is true in some cases but not in all. As growth advances, the florets develop in acropetal succession from below upwards and in all cases the anthers mature before the stigmas. Now when the lowest stigmas are ripe the anthers in the floret above it are mature. With the weight of the anthers and the aid of the wind the stamens are deflexed and the anthers of the floret are brought in contact with the stigmas of the floret just below it—thus bringing about its fertilization. In other words both self-fertilization and cross-fertilization are common. If these plants were dependent on cross-fertilization not all the florets in the spikelet would be capable of producing nuts—there would be some barren ones. During the period in which most of the Cyperaceous plants are in flower, which is during the monsoon months, there is usually little wind that is not accompanied by heavy downpours, so that whatever is in suspension in the air is washed to the ground. In the intervals between the showers little cross-ferilization could take place.

Species that grow in forests are generally protected from the wind, yet complete fertilization is effected. In the cases of *Carex* with monoecious flowers, the male flowers are situated above the female, and it is possible that when the anthers are ripe the pollen is shed and falls directly downwards on to the stigmas below. In this case the stigmas and anthers ripen at more or less the same time. But we have not had sufficient experience to express definite views on the subject, as far as this genus is concerned. No doubt insects visit some of the *Cyperaceae*, but they are few; and we think it hardly possible that every spikelet in a whole umbel should have all the florets in each spikelet fertilized in this way. Even so there is little chance of cross-fertilization, as the visiting insect may carry pollen from one part of the inflorescence to another part—this again would result in self-fertilization in so much as the pollen is from the same individual plant. The passage of insects over the spikelets would have the same result to a large extent by the deflection of the stamens.

The net result of these observations is that self-fertilization is not uncommon in this order, each set of anthers of a floret fertilizing the stigmas of the floret below it. However, there remains a great deal of work still to be done in this direction.

Seed Dispersal.

Ridley in his excellent work on the 'Dispersal of Plants throughout the World' (p. 99) rightly remarks that *Cyperaceae* do not depend very much on the wind for the dispersal of seed; we are of opinion that a certain amount of dispersal is effected in this way (though very local) in the case of plants which dry erect, and in the case of those that inhabit desert regions in the drifting sand. However, the greater part of the dispersal is probably effected by water and animal agents. Under the heading of water we might make three divisions and consider them separately: (*a*) Monsoon wash, (*b*) floods, and (*c*) rivers.

Monsoon wash: Many of the *Cyperaceae* fruit long before the monsoons terminate, for instance *Fimbristylis digitata*, *Rynchospora Wightiana*, and a few others. The two plants mentioned above are soon overtopped by other

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vegetation. The seeds drop to the ground and are probably washed away by the subsequent showers of rain. *Cyperus rotundus*, a common pest in our area, and *C. compressus* also flower early during the monsoon. The inflorescences break up, and they must be dispersed in the same way.

Floods: Floods, though not very largely responsible for the dispersal of seed must nevertheless disperse a good deal at the first onrush; and not only seed, but also entire plants and underground portions. Thus, Clarke states (ex Ridley), *Cyperus cephalotes* and *C. platystylis* are dispersed. Both species form floating masses in tanks and ricefields. Large quantities of earth are also washed away and in this there surely must be quantities of seed, etc.

Rivers: Along the banks of rivers and streams numerous *Cyperi* grow and it is doubtless that many seeds fall into the water directly or indirectly; whether the seeds sink or float is immaterial for they are certainly washed along with the silt. Now the banks of rivers are always changing, large masses of earth with the vegetation fall into the stream and are washed down whole.

Animals: We think animals are the greatest agents for the dispersal of seed. In this case the seeds may be carried internally or externally for great distances before they are dropped.

Internally: Many animals eat Cyperaceous plants along with other herbaceous vegetation. We have observed cattle eat *Cyperus Iria*, inflorescence and all. It is quite possible that many of these seeds are proof against the gastric juices and pass out unchanged in the droppings. Elephants after they have uprooted a 'trunk full' of stuff are in the habit of dusting the tuft on their bodies either for the purpose of freeing it of obnoxious insects or for driving away tantalizing insects and in so doing disperse the seed.

Beasts of prey kill a number of herbivorous animals, and the stomach contents are left where the prey has been eaten. We have frequently come across quantities of seeds left in this way.

Externally: The seeds of *Cyperaceae* fall to the ground and are soon mixed with the wet soil during the monsoon and in marshy ground. Animals passing through these muddy tracts collect a quantity of the mud on their legs and in between their hoofs, and in this way carry seed from one place to another. Wallowing animals such as pigs, elephants and the buffalo carry away clots of mud on their bodies which in all probability contain seed. These do not leave the animal till dry. In the meantime the animal may have travelled far from the place where it collected the earth.

Birds: Numerous birds such as quail, partridge, and grouse, eat the seeds of Cyperaceous plants; but it is quite likely that in these cases the seeds are digested, as they constitute the food of these birds. Large numbers of grain feeding birds are killed by birds of prey whereby the contents of the crops are discarded.

But the greatest chance of dispersal lies with the swimming and wading birds who visit places where *Cyperaceae* grow in abundance, such as rivers and lakes. These birds invariably collect quantities of seed on their plumage as they brush through the vegetation on the banks of the rivers and lakes, and on their bills and feet with the mud which adheres to them, and is in this way transported great distances.

Man: Man is by no means to be overlooked in this connection as there is no doubt that he transports many species with articles of commerce such as grain, grass, and other produce of the fields. Few Cyperaceous plants are transported from one place to another for garden purposes. Some are cultivated by the poorer classes in India, such as *Scirpus grossus*, for their edible tubers, while *Cyperus corymbosus* is said to be cultivated for purposes of mat making; but in either case this cultivation is by no means systematic.

Herbaria Examined.

(1) Herbarium of St. Xavier's College, Bombay.
Collectors: Blatter, Hallberg, McCann, Sabnis, D'Almeida (a few specimens), and Vakil (a few specimens).

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(2) Herbarium of Sedgwick and Bell (now) at St. Xavier's College, Bombay.
Collectors: Sedgwick, Bell, and their collectors.
(3) Herbarium of the Economic Botanist (H.E.B.B.), Agricultural College, Poona.
Collectors: Gammie, Paranjpye, Bhide, Garade, Patwardhan, Chibber, Ryan, and Cooke.
(4) Herbarium of Talbot (now) at The Agricultural College, Poona.
Collector: Talbot.
(5) Herbarium of the Botanical Survey of India, Sibpur, Calcutta.
This herbarium is extremely poor in material from the Bombay Presidency. The specimens are mostly a few duplicates from the Poona collection.
(6) Herbarium of Woodrow (now) at The Bombay Natural History Society, 6, Apollo Street, Bombay.
A poor collection—few sheets having any definite locality.
(7) Herbarium of Dalzell (now) at The Imperial Forest Institute (H.I.F.I.), Dehra Dun.
Poor material, and without any precise locality—just 'Bombay Presidency'.
(8) Herbarium of the Gujarat College, Ahmedabad.
Collectors: Sedgwick and Saxton.
(9) Herbarium of McCann, Bombay.
Collector: McCann.

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Some General Notes.

This is perhaps one of the most difficult orders to work for many reasons.

(1) The development of *Cyperaceae* from the seed to the mature plant often presents several different stages.
(2) Wet and dry season forms offer many varying characters.
(3) Specimens growing in or near water differ from those occupying drier soil.
(4) If characters are not noted in the field they are generally lost in herbarium material, and only personal touch and constant work both in the herbarium and in the field can clear these difficulties.
(5) Size of individuals depends much on the type of soil and season at which they are collected.
(6) Like the *Gramineae* most of the *Cyperaceae* will grow out of season if in suitable localities; but these specimens usually present certain characters unlike the 'proper season' forms.

Key to the genera (after Fischer):

A. Nut not enclosed in an utricle
I. Nut-bearing glumes containing perfect stamens as well
1. Empty glumes at base of spikelets 0-2
a. Glumes distichous (see also 8. *Fimbristylis*); hypogynous bristles 0
* Stigmas 2
† Rhachilla deciduous as a whole ... 1. *Kyllinga.*
†† Rhachilla persistent
§ Nut compressed radically to the rhachilla ... ... 2. *Pycreus.*
§§ Nut compressed tangentially to the rhachilla ... ... 3. *Juncellus.*
** Stigmas 3 or style subentire
† Rhachilla persistent ... ... 4. *Cyperus.*
†† Rhachilla deciduous above the 2 lowest glumes leaving a knob
§ Keels of nut-bearing glumes not winged ... ... 5. *Mariscus.*

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§§ Keels of nut-bearing glumes winged — 6. *Courtoisia*.

b. Glumes spirally arranged (basal ones sometimes distichous in 8. *Fimbristylis*); hypogynous bristles or scales sometimes present

* Style-base dilated and constricted or articulated above the nut

† Hypogynous bristles present; style usually persistent; leaves 0 ... — 7. *Eleocharis*.

†† Hypogynous bristles 0; leaves usually developed

§ Style-base often persistent, if falling not leaving a tumour on the nut; leaves sometimes reduced to sheaths — 8. *Fimbristylis*.

§§ Style deciduous, leaving a tumour on the nut ... ... — 9. *Bulbostylus*.

** Style-base not dilated, continuous with the nut

† Hypogynous bristles not hyaline, sometimes 0, not enveloping the nut

§ Nut with hypogynous bristles. Style-base not swollen ... ... — 10. *Scirpus*.

§§ Nut with 6 hypogynous scales, divided to the base into linear segments; stigmas 3 ... ... — 11. *Eriophorum*.

§§§ Nut with 6 or 3 or 0 scales which are not divided into segments, but petal-like. Stigmas 3 ... ... — 12. *Fuirena*.

†† Hypogynous bristles 2, hyaline, elliptic, enveloping the nut ... ... — 13. *Lipocarpha*.

2. Empty glumes at base of spikelets 3 or more

a. Stigmas 2; style-base dilated, not continuous with the nut; not beaked by the persistent style-base ... ... — 14. *Rhynchospora*.

b. Stigmas 3-fid. Lowest fertile glume somewhat distant from the one above it. — 15. *Schoenus*.

c. Stigmas 3; style-base not dilated; nut not beaked ... ... — 16. *Remirea*.

II. Nut-bearing glumes devoid of perfect stamens

1. Spikelets 2-sexual; female flower solitary, terminal; nuts not bony ... ... — 17. *Hypolytrum*.

2. Spikelets 1-sexual or the female flower basal; nuts bony

a. Spikelets usually 2-sexual, female flower basal ... ... — 18. *Scleria*.

b. Spikelets unisexual, female flower terminal ... ... — 19. *Diplacrum*.

B. Nut enclosed in an utricle — 20. *Carex*.

Spikelets many-flowered; flowers 1-sexual; rhachilla persistent; glumes not spathiform.

1. Kyllinga Rottb. (Cke. ii, 876).

Species about 50.—Tropics and subtropics.

The members of this genus are readily recognized by the capitate inflorescence at the termination of the culms. The heads vary in number from 1-7, are coloured light green, dirty white or pure white. Though the genus is easily distinguished, the species are somewhat difficult to identify.

The *Kyllingae* are for the most part monsoon species, but will flourish where there is sufficient moisture. *K. brevifolia* is particularly hygrophilous and will grow throughout the year along the banks of streams and other wet places.

Cooke in the Flora of the Bombay Presidency mentions two species: *K. triceps* and *K. monocephala*. To these Sedgwick (Journ. Bom. Nat. Hist.

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Soc. 'The Cyperaceae of the Bombay Presidency') adds two more: *K. melanocephala* and *K. brevifolia;* to these we now add one more: *K. squamulata.* Sedgwick obtained specimens at Khandala, and there were some specimens in the Herbarium of St. Xavier's College; but he was not sure of his identification. This species, though on the whole very distinct from the others occurring in the Presidency, varies much with regard to the conical teeth on the back of the glumes, even in the same head which, though given as a specific character, is not very constant.

The *Kyllingae* are very distinct when seen fresh in the field and not difficult to recognize, but herbarium material is very misleading as not much reliance can be placed on the absence or presence of the keel—this point varies too much in the same specimen. The colour of the heads, if noted when fresh, forms a very good guide, at least as far as the Bombay material is concerned.

I. Rhizome very short or 0; stems close
  1. Keel of nut-bearing glume not crested
    a. Rhizome practically 0; stems not robust, more or less thickened at the base; heads usually 3, rarely fewer or 4-5, cylindric-ovoid, central one up to 1 cm. long, others smaller, 2 upper glumes narrow ... 1. *K. triceps.*
    b. Rhizome horizontal, thick; stems 2-many, rather robust, up to 0.9 mm. high, acutely 3-angled at summit; head solitary, subglobose or ovoid, up to 1 cm. long; keel of glumes smooth, tip excurrent ... 2. *K. melanosperma.*
  2. Keel of nut-bearing glume with a broad, hyaline, toothed crest; head usually solitary, subglobose, 4.2 mm. diam.; keel of glumes excurrent and recurved ... ... 3. *K. squamulata.*

II. Rhizome elongate, clothed with oblong brown scales, stems spaced, rarely close
  1. Leaves usually much shorter than the stems; head usually solitary, subglobose or ovoid, up to 7.5 mm. long; keel of glume setulose; nut elongate ... ... 4. *K. brevifolia.*
  2. Leaves as long, longer or shorter than the stems; head usually solitary, ovoid, up to 1 cm. long; keel of nut-bearing glume with a lunate, entire crest; nut suborbicular ... 5. *K. monocephala.*

This is a copy of a key sent to C. McCann by C. E. C. Fischer which he has used in the meantime for his Flora of Madras.

1. **Kyllinga triceps** Rottb. Descr. *et* Ic. (1773) 14, t. 4, fig. 6 (*exclusa Rheedsi tab. et aliquibus synonymis*); Cke. ii, 877.

Description: Cke. ii, 877.

Locality: Without locality (Dalzell, H.I.F.I. !).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: *Ahmedabad* (Sedgwick !; Herb. St. X. C. 2164 ! 3176 !); Panch—*W. Ghats*: Khandala (Blatter, Hallberg & McCann 2405 ! 27417 !); Panchgani, exceedingly common (McCann !), Tableland (McCann 2804 ! 2872 !); Pasarni Ghat, near Panchgani (McCann 3036 !).—*Deccan*: Lena Hill, Nasik (Blatter & Hallberg 2362 !); Deolali (Blatter & Hallberg 2359 ! 2834 !); Kirkee, Mr. Gammie's compound (Garade 481 ! 555 !); Poona (Jacquemont 345 ex Cooke; Woodrow ex Cooke).—*Konkan*: Sion (Blatter, Hallberg & McCann 2431 !).—*S. M. Country*: Badami Hills (Paranjpye !); Dharwar, 2,400 ft., rainfall 35 in. (Sedgwick 2684 ! 6210 !).

Flowering & fruiting: May 21, 1902 (Kirkee); June 18, 1902 (Kirkee); July 1917 (Sion, Khandala, Dharwar); August 1914 (Ahmedabad); August 1919 (Dharwar); August 16, 18, 25, 1930 (Panchgani); September 1917 (Lena Hill, Deolali); September 1, 1912 (Badami Hills); September 3, 1930 (Pasarni Ghat).

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Field notes: Usually a short tufted species of the drier parts of the Presidency during the rains, growing on well drained ground. The heads are pale straw-coloured and quite unlike those of the other species recorded from the Presidency. In habit usually quite erect and growing in the open. The usual 3-headed inflorescence differentiates it from the other species but we have seen specimens with as many as 5-7 heads forming one compact head, appearing lobed.

'Abundant in pastures in the mid-monsoon period at Dharwar' (Sedgwick). 'A member of the sand flora' (Saxton & Sedgwick).

Distribution: Sind, Gujarat, Deccan, Konkan, S. M. Country, N.-W. India, Rajputana, Bengal, Burma.—Ceylon, Africa, China, N. Australia.

2. **Kyllinga melanosperma** Nees in Linnaea ix, 286; Boeck. in Linnaea xxxv, 419.—*K. brevifolia* Nees l.c. 91 (*partim, non* Rottb.)—*K. fuscescens* Boeck. l.c. 421 (*partim*).—*K. vaginata* (*et* var. *major*) Zoll. Verz. Ind. Archip. ii, 63.

Description: Rhizome thick, 1.3-3.8 cm. long. Stems 50-75 cm. long, triquetrous under the inflorescence. Leaves much shorter than the stems, often 10-15 cm. long, 4-5 mm. broad. Head of one spike, ovoid, dull green, 8 mm. long and more; bracts 3-4, similar to the leaves, the lowest often 10 cm. long. Spikelets numerous 3-4 mm. long, each producing 1 (very rarely 2) nut. Nut-bearing glume ovate, acute; keel not winged, almost smooth. Nut $\frac{1}{2}$-$\frac{2}{3}$ the length of the glume, narrowly obovoid, finally black.

Locality: *W. Ghats*: Panchgani, Maratha Well (Blatter & Hallberg B1738 !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4413 !).—*N. Kanara*: Sampkhand, river bank, 1,600 ft., rainfall 200 in. (Sedgwick 6982 !, Hallberg & McCann C215 !); Anmod, in a marsh (Sedgwick 3293 !).

Flowering & fruiting: October 1918 (Devarayi); October 1919 (Sampkhand); October 1920 (Panchgani); December 1917 (Anmod).

Field notes: A larger and coarser plant than any of the other species.

Distribution: W. Ghats of Bombay and Madras Presidency up to 7,000 ft., Travancore at 300 ft., Kollimalai Hills, N. Kanara, S. M. Country.—Ceylon, Malaya, S. and tropical Africa, Madagascar.

3. **Kyllinga squamulata** Vahl Enum. ii, 381; Boeck. in Linnaea xxxv, 431.—*K. Metzii* Steud. Syn. Pl. Cyp. 70.

Description: Root fibrous. Stems closely caespitose. Leaves often as long as the stem, 3 mm. broad. Head globose, usually of 1 spike, 8 mm. diam., green becoming brown; bracts 3, lowest often 10 cm. long, similar to the leaves, patent. Spikelets numerous, 3 mm. long, perfecting one nut. Nut-bearing glume crested by toothed scales coalescent into a wing on its keel. Nut $\frac{3}{4}$ the length of the glume, orbicular, dull brown.

Locality: *W. Ghats*: Khandala, on a wall (Sedgwick 7928 !, Blatter & McCann 3037 ! 3057 !); Igatpuri (Blatter & Hallberg 2807 !).—*Konkan*: At the top of the hill between Tulsi Lake and Mullund, on wet rocks (McCann 797 !); on Bund, south end of Tulsi Lake, between the blocks of stone (McCann 1280 !).—*N. Kanara*: Kanara (Metz. ex Hook. F.B.I.).

Flowering & fruiting: July 1916 (Khandala); July 1917 (Khandala); August 11, 1929 (between Tulsi Lake and Mullund); September 1917 (Igatpuri); September 22, 1929 (Tulsi Lake); October 1921 (Khandala).

Field notes: Heads a dirty white, not so compact as in the case of other species of the genus. Specimen No. 797 was growing in a dense mat on a rock over which water trickled, while specimen No. 1280 grew in between the blocks of stone of which the dam was constructed. Densely tufted.

Clarke in Hook. F.B.I. remarks that the heads are either green or brown. This may be the case in dry material but is certainly not so in fresh specimens.

The conical teeth on the back, though given as a distinguishing character of this species, are misleading as they may be present or absent even on glumes of the same head.

Distribution: W. Ghats, Konkan, S. Kanara, Kashmir, Garhwal up to 5,500 ft., Mt. Abu.—Tropical Africa, Martinique.

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Kyllinga brevifolia Rottb. growing in a drain.

Inflorescence of *Pycreus albomarginatus* Nees.

Photos by C. McCann.

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4. **Kyllinga brevifolia** Rottb. Descr. *et* Ic. (1773) 13, t. 4, fig. 3; Boeck. in Linnaea xxxv, 424 (*excl. aliquibus plantis citat.*).—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 588.

Description: Rhizome creeping, 5-20 cm. long, rarely more than 2 mm. thick. Stems usually distant, sometimes contiguous, not thickened by basal sheaths. Leaves longer than the stem or scarcely one-third its length, 3 mm. broad. Head of 1 (sometimes of 2-3) spike rarely more than 6 mm. diam., ovoid, of many spikelets, green finally dusky brown; bracts 3-4, similar to the leaves, lowest up to 10-12.5 cm. long, or (in the short-leaved examples) only 2.5-5 cm. long, patent. Spikelets 2.5 cm. long, each perfecting 1 nut. Nut-bearing glume acute, mostly without glands; keel not winged, nearly always scabrous. Nut $\frac{1}{2}$-$\frac{2}{3}$ the length of the glume, yellow-brown.

Locality: *W. Ghats*: Khandala (Sedgwick 2571 !, Blatter & McCann 3033 ! 3041 !), on edge of a stream (McCann 400a ! 400b ! 402 ! 343 ! 346 !); Matheran (Paranjpye !); Mahableshwar (Sedgwick 7650 !); Panchgani (McCann 2780 ! 3003 !, Fernandez C213 ! C214 !); Castle Rock (Sedgwick 2755 !). —*Deccan*: Poona (Blatter 3129 !).—*Konkan*: Bombay, marshy soil near water pipe (McCann 464 !); Bhandup to Vehar Lake, on bank of a stream (McCann 637 !); Bhandup (Sedgwick, Herb. Nana 7685 !); Parel (Blatter, Hallberg & McCann 3099 ! 5377 !); Sion (Blatter & McCann 5243 !); Foot of hills N.-W. of Mulland, in humus under shade of bushes (McCann 796 !).—*S. M. Country*: Devarayi, in a marsh, 1,800 ft., rainfall 80 in. ? (Sedgwick 4096 !), forests (Sedgwick 4016 ! 4099 ! 4104 ! 4110 ! 4111 !).—*N. Kanara*: Karwar, rice fields (Talbot !, Sedgwick 5073 ! 6513 !); Yellapur (Talbot !); Dandeli (Bell 4202 !); Gersoppa Falls, 1,400 ft., rainfall 200 in. (Sedgwick 7151 !, Hallberg & McCann C211 ! C212 !).

Flowering & fruiting: February 1917 (Parel); March 29, 1929 (Khandala); April 15, 1929 (Khandala); June 24, 1929 (Bombay); July 1917 (Khandala); July 1918 (Devarayi); July 7, 1929 (Bhandup to Vehar Lake); August 1917 (Castle Rock); August 1918 (Dandeli); August 1, 1885 (Karwar); August 11, 1929 (N.-W. of Mulland); August 18, 1930 (Panchgani); August 25, 1911 (Matheran); August 31, 1930 (Panchgani); October 1884 (Yellapur); October 1919 (Karwar, Gersoppa Falls); October 1920 (Mahableshwar, Bhandup); November 12, 1916 (Sion); December 1918 (Karwar).

Field notes: Perhaps the most hygrophilous species of the Presidency and also the commonest. Usually growing in soft sticky soil along the banks of streams and often entering the water. The heads are pale green. The longest bract stands almost upright as though it were a continuation of the stem. The roots and rhizome are strongly aromatic—having a 'gingery' smell. In the field it is easily distinguished at a glance from other Bombay species by its solitary pale green head and its dense matted habit and situation, but herbarium material is difficult to distinguish and requires very careful examination.

Distribution: Throughout India.—Ceylon, Malacca. All warm regions except the Mediterranean.

5. **Kyllinga monocephala** Rottb. Descr. *et* Ic. (1773) 13, t. 4, fig. 4; Cke. ii, 876.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 589.

Description: Cke. l.c.—This species has a distinct though narrow wing along the keel of the nut.—*K. brevifolia* has not but has from 1-4 setae.

Locality: *W. Ghats*: Khandala (Gammie 15385 !), Londa (H.E.B.B. !, Cooke ex Cooke).—*Konkan*: Bombay St. X. C. compound (McCann 2396 ! 2398 !), Victoria Gardens (McCann 722 ! 726 !); Sewri, Bombay Island (Blatter & McCann 3073 !); Bhandup (Blatter & McCann 2434 !); Bhandup to Vehar Lake, in shade of mango tree (McCann 642 ! 643 !); Versova (Blatter & McCann 2828 ! 2898 !); Kondita, Salsette Isl. (Blatter & McCann 2441 !); Bandra (Ryan 1400 !); fields behind Bandra Hill (Vakil C208 !); Sion (Blatter & McCann 2427 !), under shade of tree (McCann 938 ! 941 ! 942 ! 943 ! 944 !); Vetora (Sabnis 33441 ! 33521 !).—*S. M. Country*: Tadas, Dharwar Dist., shady place, 2,200 ft., rainfall 35 in. (Sedgwick 1956 !); under shade of trees, Kunnur, Dharwar Dist. (Sedgwick 4931 !).—*N. Kanara*: Yellapur (Talbot !); Karwar, on grassy ground (Sedgwick 6514 !).

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Flowering & fruiting: May 1918 (Vetora); July 1917 (Kondita); July 7, 1929 (Bhandup to Vehar Lake); July 22, 1929 (Victoria Gardens); August 1918 (Bandra); August 25, 1929 (Sion); September 1884 (Yellapur); September 1917 (Versova); September 8, 1903 (Bandra); September 20 (Khandala); October 1891 (Londa); October 1919 (Karwar); December 1916 (Tadas); December 1918 (Kunnur); December 1919 (Victoria Gardens).

Field notes: Heads solitary, pure white. Anthers and filaments also pure white when fresh. The white head is a very characteristic point in this species. The anther and filaments stand straight out when fresh.

A plant of the shade, generally growing under the shade of trees where there is a good supply of humus. Not just a monsoon species, for it may be seen throughout the year in flower when there is sufficient moisture, particularly near waterpipes in gardens when they are in the shade. In the 'wild' state it dies down soon after the rains. The rhizomes run almost parallel to the surface of the ground and are never very deep.

Specimen 941 from Sion was growing among other plants and probably in consequence became very elongate in all its proportions and did not represent the usual short upright habit of the plant.

Distribution: Throughout India, Ceylon, Singapore.—Hot and warm regions of the Old World, except the Mediterranean.

2. Pycreus Beauv. (Cke. under *Cyperus*).

Stems leafy at the base or sometimes above. Inflorescence of 1-many corymbose-subumbellate spikes, sometimes fascicled; umbel usually simple. Glumes distichous, 4-very many, 2 lowest empty, the next bisexual, the uppermost 1-3 sterile or empty. Rhachilla persistent. Stamens 1-3. Style 2-fid. Nut laterally compressed in the plane of the rhachilla.—Species about 100.—Cosmopolitan.

In the Flora of the Bombay Presidency, Cooke includes the three genera, *Pycreus*, *Juncellus*, and *Mariscus* in the genus *Cyperus*. Sedgwick in his paper on the *Cyperaceae* of the Bombay Presidency, in the Journal of the Bombay Natural History Society, follows the same system with the exception of *Mariscus* which he separates. We do not agree with Cooke's treatment of these genera, nor entirely with that of Sedgwick. Though this view is controversial we think that the characters of *Pycreus* and *Juncellus* are sufficiently distinct from those of *Cyperus*, and between themselves, to separate them into totally distinct genera. The 2-fid style (occasionally 3-fid) combined with the characters of the nut (though somewhat artificial) are of sufficient value to separate these two genera from *Cyperus*. There is also one more character (which to our knowledge has been overlooked by Cyperologists so far) which we wish to bring forward in favour of the separate treatment of these genera and that is the character of the rhachilla which is totally distinct in configuration in these three genera. This difference between the rhachilla of these three genera is perhaps best explained by way of figures (See Pl. I). In the genus *Cyperus* the rhachilla for the most part is broadly or narrowly winged by the decurrent margins of the glume, but this is not the case in the true sense of the word in either *Pycreus* or *Juncellus*. The naked rhachilla in these three genera clearly shows a distinct type and appears to be good ground for their separation.

In *Mariscus* the disarticulation of the rhachilla above the two empty glumes appears to us to be of real morphological importance. This is not the case in any of the three preceding genera. Cooke is certainly incorrect when he states that this character 'cannot be applied in the field, but may be said to be limited to herbarium specimens' (Fl. Bomb. Pres. ii, 853). We are in agreement with Sedgwick who holds the opposite view. As a matter of fact, when the spikelet of a *Mariscus* is ripe it comes away easily even at the slightest touch. Articulations are not apparent when the parts are immature. Lastly, the morphology of the spikelet including the shape and construction of the glume is far removed from the typical *Cyperus* spikelet which cannot be said of *Pycreus* and *Juncellus*.

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All the species of this genus that occur in the Presidency may be classed as annuals or plants that will grow at any time of the year if in a suitable locality.

Of all the species *P. globosus* All. is perhaps the most common and shows the greatest amount of variation which makes it exceedingly difficult to define and identify. *P. albomarginatus* is the largest species that occurs in the Presidency, and is readily distinguished. *P. polystachyus* Beauv. is another variable plant.

Key after Sedgwick:

A. Superficial cells of the nut longitudinally elongate. Ripe nuts usually appearing irregularly zonate by the short sides of the cells running into a wavy line.	
1. Nut black, narrowly obovoid, subacute, not much compressed, the transverse ridges prominent, glistening white	1. *P. flavescens.*
2. Nut black, broadly obovoid, obtuse, rather compressed, the transverse ridges distinct, not white	2. *P. latespicatus.*
3. Nut black, quite concolorous, almost completely rotund, very compressed, the transverse ridges rather obscure	3. *P. malabaricus.*
B. Superficial cells of the nut quadrate. Ripe nuts not zonate	
1. Spikelets short, broad, 3 mm. reddish ...	4. *P. sanguinolentus.*
2. Spikelets elongate, many-flowered, with parallel sides, 3 mm., stem robust, 30-60 cm. ...	5. *P. puncticulatus.*
3. Spikelets gradually attenuated from base to tip, glumes lax, yellow, with prominent white margin	6. *P. albomarginatus.*
4. Spikelets elongate (as 2) but stems slender; tufted, 20-45 cm.	7. *P. globosus.*
5. Spikelets narrow, pale, in contracted umbels; perennial, maritime	8. *P. odoratus.*
6. Small and slender; spikelets few-flowered with hump-backed glumes with strong, raised, curving nerves on the sides	9. *P. hyalinus.*
7. Small and slender, spikelets many-flowered, elongate, parallel-sided, with normal glumes	10. *P. pumilus.*

1. **Pycreus flavescens** Nees in Linnaea ix, 283.—*Cyperus flavescens* Linn. Sp. Pl. (1753) 68.

Description: An annual, slender herb. Stems 3-30 cm. high. Leaves often ¾ the length of the stem, 2 mm. wide, grass-like. Umbel simple or reduced to one head; bracts spreading; spikelets clustered, or very shortly spicate, linear, 2.5 mm. wide, yellow or pale, spreading in fruit. Nut obovoid, compressed, shining black, with transverse white lines, hardly half as long as the glume; black cells of surface longitudinally oblong.

The Tambad specimen of Woodrow was identified as *P. malabaricus*.

Locality: *W. Ghats*: Khandala (Gammie 15386 !, H.E.B.B. !, McCann C197 !); Purandhar (Blatter & McCann 5584 !).—*Deccan*: Tambad, Mawal (Woodrow !).—*N. Kanara*: (Chibber !).

Flowering & fruiting: September 20, 1895 (Khandala); September 20, 1902 (Khandala); November 1910 (Kanara); December 1917 (Purandhar).

Distribution: N. temperate regions.

2. **Pycreus latespicatus** C. B. Clarke in Hook. f. F.B.I. vi, 590.—*Cyperus latespicatus* Boeck. in Flora xlii, 433 (of No. 28, July 1859, not of No. 27); Cke. ii, 855.—Synonyms in F.B.I. l.c.

Description: Cke. l.c. (under *Cyperus*).—Filaments persistent on the rhachilla in dried material.

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Locality: *W. Ghats*: Mahableshwar, rocky summit of Sindola Plateau 4,700 ft., rainfall 300 in. (Sedgwick 4850 !, Ryan 1523 !); Lingmala (McCann 3419 ! 3375 !); Panchgani (Blatter & Hallberg B1747 !, Blatter 1986 !, McCann 2753 ! 2805 !), marshy banks of a watercourse (Fernandez C172 ! C173 !); Khandala (Chibber !); Lonavla (Blatter & McCann 2491 !).—*Deccan*: Mawal (Woodrow !).—*Konkan*: (Stocks, Law, ex Cooke); Borivli to Kanari Caves, in open grassland (McCann 1120 !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 290 in. (Sedgwick 4465 !).—*N. Kanara*: Sirsi, 1,600 ft., rainfall 100 in. (Sedgwick 7263 !); Yellapur (Talbot 1023 !).

Flowering & fruiting: August 16 and 18, 1930 (Panchgani); August 28, 1929 (Panchgani); September 1917 (Lonavla); September 20, 1884 (Yellapur); September 24 and 27, 1930 (Lingmala); October 1908 (Panchgani); October 1918 (Devarayi); October 1919 (Sirsi); October 1920 (Panchgani); November 1918 (Mahableshwar); November 9, 1893 (Mawal).

Field notes: Spikes reddish brown, turning reddish in herbarium material; very pale spikes are also very common.

Umbel occasionally reduced to a single spikelet. Growing in the open, usually associated with other short species.—Purely a monsoon species; tufted—many stems arising from one point—not quite erect, usually inclined at an angle, solid, one side compressed, the other rounded.

Distribution: W. Ghats, Deccan, Konkan, S. M. Country, N. Kanara.—More or less throughout India.

3. **Pycreus malabaricus** C. B. Clarke Journ. Linn. Soc. v, 34 (1898) 12.—*Cyperus malabaricus* C. B. Clarke l.c.; Cke. ii, 856.

Description: Cke. l.c.

Locality: *W. Ghats*: Igatpuri (Blatter in Sedgwick's Herb. 3188 !; Blatter & Hallberg 2845 !); Lonavla (Woodrow ex Cooke; Blatter, Hallberg & McCann 3146 !); Khandala (Cooke; Blatter, Hallberg & McCann 3044 !, H.E.B.B. !).—*N. Kanara*: Arbail Ghat, grassland, 1,500 ft., rainfall 300 in. (Sedgwick 6584 !); Siddhapur, grassland, 1,600 ft., rainfall 100 in. (Sedgwick 7247 !); Karwar, abundant (Sedgwick 6599 !; Hallberg & McCann C101 !).

Distribution: Apparently endemic.

4. **Pycreus sanguinolentus** Nees in Linnaea ix (1835) 283.—*Cyperus sanguinolentus* Vahl Enum. ii (1806) 351; Cke. ii, 856.—Synonyms in F.B.I. vi, 590.

Description: Cke. l.c. (under *Cyperus*).—Cooke states that the spikes are 'reddish brown' and that the glumes are 'greenish yellow'. The colour reddish brown in the spikes is certainly due to the colour of the glumes which are reddish brown. We do not understand the contradiction. Further on in the description he says that the sides of the glumes are reddish brown—the margins and keel are certainly paler.

Locality: *Sind*: (Pinwill ex Cooke).—*W. Ghats*: Khandala (Woodrow ex Cooke, McCann 3196 ! C110 !, Blatter & McCann 3160 ! 3191 !, Gammie 15407 !, H.E.B.B. !), in a marsh near the station (McCann 389 ! 403 !); Igatpuri (Blatter & Hallberg 2810 ! 2818 ! 3009 ! 3016 !, McCann 2380 !); Panchgani, in the bed of a watercourse (Fernandez C159 !); Castle Rock, 1,600 ft., rainfall 250 in. (Sedgwick 2715 !).—*Deccan*: Talegaon (Blatter 3149 !); Khandala to Talegaon (H.E.B.B. !).—*Konkan*: Mulland, in a marsh (McCann 811 !); Kalyan (Woodrow 11 ex Cooke).—*S. M. Country*: Alnavar, 2,000 ft., rainfall 40 in. (Sedgwick 2924 !); Bidi, Dharwar Dist., 2,500 ft., rainfall 50 in. (Sedgwick 3038 !).—*N. Kanara*: Hattikeri, Karwar, in a pool (Herb. Sedgwick & Bell 6765 !, Hallberg & McCann C109 !); Karwar, in rice fields (Talbot 1516 !); Yellapur (Talbot !); Hangal (Chibber !).

Flowering & fruiting: March 1917, March 29, 1929, April 15, 1929, and May 1917 (Khandala); August 1917 (Castle Rock); August 10, 1885 (Karwar); August 11, 1929 (Mulland); September (Talegaon); September 1884 (Yellapur); September 1917 (Alnavar, Bidi); September 1918 (Khandala); September 20, 1895 (Khandala); September 26, 1895 (Khandala to Talegaon); October 1919 (Hattikeri); October 26, 1910 (Hangal).

Field notes: A plant of the marshes and open grassland where there is plenty of water in the soil during the monsoon. The stems are comparatively weak, always drooping when long—single or in small clusters.

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F. B. Das, del. *Pycreus malaccensis* C. B. Clarke.

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A good species. Comparatively easy to distinguish both in the field and the herbarium.

Flourishes throughout the year in marshes only, otherwise a monsoon species.

Spikelets chocolate brown or dark reddish brown becoming a brighter red when dry. Stems 3-gonous.

Distribution: Sind, Konkan, W. Ghats, Deccan, S. M. Country, N. Kanara, throughout India, Ceylon.—Warm parts of the Old World.

5. **Pycreus puncticulatus** C. B. Clarke in Hook. f. F.B.I. vi, 593.—*P. Baccha* Nees in Linnaea ix (1835) 283.—*Cyperus puncticulatus* Vahl Enum. ii (1806) 348; Cke. ii, 858.

Description: Cke. l.c.

Locality: *Konkan*: (Dalzell ex Cooke).—*W. Ghats*: Londa (Cooke).—We have seen no specimen from the Presidency.

Distribution: W. Peninsula.—Ceylon, China.

6. **Pycreus albomarginatus** Nees in Mart. Fl. Brass. ii, pt. i (1842) 9.—*Cyperus albomarginatus* Mart. & Schrad. ex Nees in Fl. Bras. ii, pt. i (1842) 9; Cke. ii, 858.—*C. Hochstetteri* Nees ex Krauss in Flora xxviii (1845) 755, *in nota*.

Description: Cke. l.c. (under *Cyperus*).

Locality: *W. Ghats*: Igatpuri (McCann 2377 ! 2378 !); Khandala, St. Mary's Villa grounds (McCann C103 !); Castle Rock (Gammie !); Londa (Gammie !, Woodrow ex Cooke).—*Konkan*: (Stocks ex Cooke); N. & S. Konkan (Law ex Cooke); Bombay (ex Herb. Hook. in Herb. Kew. ex Cooke); Budlapur (Herb. St. X. C. 3150 !); Vetora (Sabnis 33763 !); near Budlapur (Woodrow !, H.E.B.B. !); Karjat to Palasdari (H.E.B.B. !); Borivli to Kanari Caves, margin of a tank (McCann 1107 ! 1108 ! 1099 !); Varol Tank, Bhivandi, near Kalyan (McCann 1711 !).—*S. M. Country*: Alnavar, 2,000 ft., rainfall 40 in. (Sedgwick 3054 !); Kasgod (Sedgwick 2974 !).—*N. Kanara*: Sejwad, near Karwar, in a tank (Sedgwick 6722 !); Yellapur, 1,500 ft., rainfall 100 in. (Sedgwick 6583 !); Karwar (Hallberg & McCann C104 !); Sampkhand (Hallberg & McCann C105 !); Haliyal (Talbot !).

Flowering & fruiting: September 1917 (Kasgod, Alnavar); September 1918 (Khandala); September 15, 1929 (Borivli to Kanari Caves); September 20, 1888 (Haliyal); September 27, 1895 (near Budlapur); October 1899 (Londa); October 1902 (Castle Rock); October 1917 (Igatpuri); October 1919 (Sampkhand, Karwar, Sejwad).

Field notes: A good species. Purely a monsoon species commencing to flower about the last week in August. Dies down completely after the rains.

A plant of 'dry' ground and in the shallow water of tanks, growing among other plants. When on 'dry' ground a much shorter and robust plant, when in water grows taller with larger umbels. Umbels generally very large but we have seen specimens with the inflorescence reduced to a few spikes. Umbel 50 cm. across.

Stem terete below, near the base, 3-gonous with rounded angles above. Leaves as long as the stem or slightly longer. Umbel-rays 14, 23.8 cm. long, secondary rays 5.2 cm. Bracts reaching 89 cm. by 12 mm.

A robust plant with a large spreading umbel readily distinguished in the field when mature, but very young specimens are very often difficult to place.

Spikelets brown, frequently becoming reddish in the herbarium.

The largest and most characteristic of the *Pycreus* species in the Presidency. The species *puncticulatus* approaches it [from the single specimen seen in the Calc. Herb. (not from the Presidency)] but we have seen no specimens of this plant from our area.

Distribution: Konkan, W. Ghats, S. M. Country, N. Kanara, Quilon, Rangoon.—Ethiopia, N. Australia.

7. **Pycreus globosus** Reichb. Fl. Germ. Excurs. 140[10] (1830-32).—*P. capillaris* Nees in Linnaea ix (1834) 283.—*Cyperus globosus* All. Auct. Fl. Pedem. (1789) 49; Cke. ii, 857.—*C. nilagiricus* Hochst. ex Steud. Syn. Pl. Glum. ii, 2.—*P. capillaris* var. *nilagiricus* C. B. Cl. in Journ. Linn. Soc. xxi, 49.—*P. globosus* Reichb. var. *nilagirica* C. B. Cl. in Durand & Schinz Consp. Fl. Afri. v, 537.

Description: Cke. l.c. (under *Cyperus*).

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Specimen No. 5576 has spikelets which measure 36 mm. against Cooke's measurements.

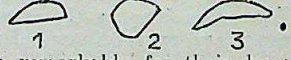
C. B. Clarke (Fl. Trop. Africa viii, 300) says: 'The species *nilagiricus* was originally grounded on the black-chestnut colour, while my var. *nilagirica* includes all the narrow spikeleted heads whatever the colour'. We quite agree with Cooke (ii, 858) when he says that this character is not a reliable one and we therefore drop the var. *nilagirica*.

Parker (Flora of the Upper Gangetic Plain, vol. iii, pt. iii, 338) holds the same view with regard to var. *strictus* C. B. Clarke, as it appears to be connected with the type by all grades of intermediates.

Haines (Bot. Bihar & Orissa, 904) made a *nov. comb.* of *P. globosus*. He was evidently not aware of Reichenbach having been the first to use that name.

Locality: *Gujarat*: Nalas near the Bokh, Prantij (Sedgwick 256 !).—*Khandesh*: Amalner, Bori River (Blatter & Hallberg 1970 !); Bori River (Blatter & Hallberg 1990 !); Tapti River (Blatter & Hallberg 3026 !); Bor, Tapti River (Blatter & Hallberg 3012 ! 3032 !); Bhusawal, Tapti River (Blatter & Hallberg 3087 !); Dhulia (Chibber !); Noti tank (Chibber !).—*W. Ghats*: Khandala (Blatter & McCann 3181 !); Purandhar (Blatter & McCann 5575 ! 5576 ! 5587 !); Mahableshwar (Chibber !, Woodrow ex Cooke); Panchgani, below 3rd Tableland (McCann 3224 !).—*Deccan*: (Dalzell & Gibson ex Cooke); Nasik (Blatter & Hallberg 2822 !, Kuntze); Gungapur, Nasik (Blatter & Hallberg 2831 !); Poona (Cooke, Belkar !, Jacquemont 409 ex Cooke), riverside (Bhide 3 ! 22 !); Mangri, near Poona (Gammie 15341 !); Ganeshkhind Gardens (Garade 431 !); Soos, 8 miles N.-W. of Poona (Babajee !, Bhiva ex Cooke); Hura (Dalzell ex Clarke).—*Konkan*: (Stocks, Law ex Cooke); Bhandup (Blatter & McCann 2415 !); near Kalyan (H.E.B.B. !).—*S. M. Country*: Havasbhavi, fields, 1,800 ft., rainfall 35 in. (Sedgwick 2095 !); Bagalkot (Patwardhan !).—*N. Kanara*: Yellapur, rice fields (Talbot 2950 !).

Flowering & fruiting: January 25, 1925 (Sangli); February 11, 1904 (Mangri); March 1917 (Khandala); March 17, 1908 (Mahableshwar); March 24, 1929 (E. of Tulsi Lake); March 31, 1929 (Khandala); April 17, 1906 (Bagalkot); May 8 and 9, 1902 (Poona); June 1917 (Bhandup); June 13, 1902 (Ganeshkhind); August 17, 1902 (Mangri); August 22, 1929 (Sivapur); August 28, 1929 (Panchgani); September 1906 (Bawada); September 1917 (Gangapur, Nasik); September 1919 (Khandala); September 20, 1895 (Poona); September 28, 1884 (Yellapur); September 29, 1895 (Kalyan); October 1914 (Sonasan); October 24, 1929 (Gorair Bridge); October 29, 1890 (Soos); November 12, 1929 (Panchgani); December 1916 (Bhusawal, Bor, Amalner, Tapti River); December 1917 (Purandhar); December 27, 1907 (Dhulia).

Field notes: A most variable species. A plant generally found in marshes, river-beds and about springs. If there is sufficient moisture it will flourish all the year round. The specimens from the northern part of the Presidency (Gujarat) are generally much larger and with paler spikelets than those from the southern part of the Presidency (Sedgwick also remarks on the point of colouring). The stem may have different forms in section 

The Panchgani and Mahableshwar specimens are remarkable for their long bracts; margin serrulate.

The inflorescence rapidly breaks up when mature.

This plant is so variable, that it is difficult to define the specific limits.

Saxton and Sedgwick found this plant in Gujarat in close association with *Fuirena glomerata* Lam.

Distribution: Throughout India, Ceylon.—Most temperate and tropical regions of the Old World.

5. **Pycreus odoratus**. Urban Symb. Antill. ii, 164.—*P. polystachyus*, Beauv. Fl. Owar. ii, 48, t. 86, fig. 2.—*Cyperus odoratus* Linn. Sp. Pl. (1753) 46; Cke. ii, 859.—*C. polystachyos* Rottb. Descr. et Ic. (1773) 39, t. 11, fig. 1.—*C. ferrugineus* Poir. in Lam. Encycl. vii, 261.—*Pycreus ferrugineus* C. B. Clarke in Hook. f. F.B.I. vi, 593.

Description: Cke. l.c. (under *Cyperus*).

Locality: *Sind*: (Pinwill ex Cooke).—*Cutch*: Near the coast (Blatter ex

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J.B.N.H.S.).—*Gujarat*: Surat (Woodrow ex Cooke).—*W. Ghats*: Dudhsagar Falls (McCann C187 ! C188 !); Castle Rock, 1,700 ft., rainfall 200 in. (Herb. Sedgwick & Bell 5680 !).—*Konkan*: Sion, in a marsh near railway station (McCann 967 ! 967a ! 967b !); Kurla, marshes (McCann !); Vickroli (McCann !); Malvan (Woodrow ex Cooke).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4042 !); Siddhapur Taluka (Talbot in Calc. Herb. !).—*N. Kanara*: Karwar, near the sea (Sedgwick 5081 !), salt marshes (Sedgwick 5102 !), on Light-House Island (Bell 7732 !), by a pool, Hattikeri (Herb. Sedgwick & Bell 6766 !, Hallberg & McCann C101 ! C180 !), on sandy soil (Talbot 1255 !).

Flowering & fruiting: March 1919 (Castle Rock, Dudhsagar); June 1918 (Devarayi); June 25, 1885 (Karwar); August 1918 (Sulgeri); August 28, 1929 (Sion); October 1919 (Karwar, Hattikeri); December 1918 (Karwar).

Field notes: A densely tufted species growing in marshes. Roots strongly aromatic. Inflorescence pale brown, becoming darker and turning reddish when drying. Stems 3-gonous becoming bilaterally compressed above under the umbel. Dies down after the monsoons or the culms remain without the inflorescence. Quite common around Sion and Kurla during the monsoon. Commences flowering in early July. The inflorescence is very variable.

In Sion we have found it growing together with *Fimbristylis polytrichoides*.

Uses: A good sand-binding species (Prain).

Distribution: Throughout India near the coast.—All warm, especially maritime regions.

9. **Pycreus hyalinus** Dom. in Biblioth. Bot. lxxxv (1916) 417.—*Cyperus hyalinus* Vahl Enum. ii (1806) 329; Cke. ii, 857.—*C. pumilus* Nees in Wight Contrib. (1834) 74 (*non* Linn.).—*Pycreus pumilus* Nees in Linnaea ix (1835) 283; C. B. Clarke in Hook. f. F.B.I. vi, 591.

Description: Cke. l.c.

Locality: Without locality (Dr. Leith 25 ex Cooke).—*Konkan*: Sion (H.E.B.B. !, Blatter & McCann 3151 !).

Flowering & fruiting: September 1917 (Sion).

Distribution: Konkan, about Madras City, Satiamangulam, Coimbatore District, Pulney Hills at 6,000 ft.—Ceylon, Timor.

Apparently an extremely rare species. McCann has repeatedly visited the stated locality in recent years to obtain further information about this species, but has not succeeded in finding a single specimen.

Sedgwick, Rec. B. Sur. of Ind. vol. vi, p. 304—'Plants of Northern Gujarat', mentions this species as occurring in Gujarat. Evidently this is a mistake for *P. pumilus* Dom. as this species has never been found in the Presidency outside Sion, and, in his Cyperaceae of the Bom. Pres. in the Journ. Bom. Nat. Hist. Soc., Sedgwick remarks under the species 'Very rare. Apparently only from Sion, Bombay.' This paper was published subsequent to the 'Plants of Northern Gujarat' though in the same year. *P. hyalinus* does not occur in Gujarat, but *P. pumilus* is extremely common.

10. **Pycreus pumilus** Dom. in Biblioth. Bot. lxxxv (1916) 417.—*Cyperus pumilus* Linn. Amoen. Acad. iv (1788) 302; Cke. ii, 857.—*C. nitens* Retz. Obs. v (1789) 13 ?.—*C. pulvinatus* Nees et Meyen in Wight Contrib. (1834) 74.—*Pycreus pulvinatus* Nees in Linnaea ix (1834) 283.—*P. nitens* Nees l.c.; C. B. Clarke in Hook. f. F.B.I. vi, 591.—*C. pygmaeus* Retz. Obs. iv, 9—*C. pusillus* Vahl Enum. ii, 303.

Description: Cke. ii, 857 (under *Cyperus*).—Bracts reach 17.4 cm.

	Cooke's measurements.	Our measurements.
Bracts:	up to 4½ in.	up to 17 cm.
Spikelets:	20-50-flowered	9 upwards.

All the Floras state that this species has 1-2 stamens (usually one). All the specimens examined of this species have 3 stamens. One anther is on a long filament, the other two filaments are short (one shorter than the other) and close to the nut. The long filament is the only one which shows itself

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clearly and a careful dissection is needed to disclose the other two. These two are displaced early by the developing nut leaving the long solitary stamen.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Godhra (H.E.B.B. !).—*W. Ghats*: Khandala (McCann 3184 ! C119 ! C120 !, Gammie 15387 !), in a marsh near the station (McCann 351 !); Lonavla (Blatter, Hallberg & McCann 3148 !, Woodrow !).—*Deccan*: Bhusi, Mawal, Poona (Supt. of Lonavla Farm 9 !); Mawal (Woodrow ex Cooke); between Nadsur and Pali, in rice fields (Gammie 16047 !).—*Konkan*: (Stocks, Law ex Cooke); Bombay Isl. (Herb. St. X. C. 2799 !), Dhobi Talao (Blatter & McCann 3092 !); Pen (Blatter, Hallberg & McCann 3227 !); Mulland, open ground (McCann 897 ! 903 !); Sion Hill (McCann 936 !); Borivli to Kanari Caves (McCann 1161 !).—*S. M. Country*: Alnavar, 2,000 ft., rainfall 40 in. (Sedgwick 2938 !).—*N. Kanara*: Hattikeri to Karwar, hillside, in rock crevices (Sedgwick & Bell 6770 !); Karwar, growing on old cart tracks (Talbot 1513 !); Dandeli, sand of river, 1,800 ft., rainfall 100 in. (Bell 4225 !); Yellapur (Talbot 983 !); Sanikalta, sea shore (Chibber !); Kanara (Woodrow ex Cooke).

Flowering & fruiting: February 1917 (Pen); March 1917 (Khandala); March 29, 1929 (Khandala); April 15, 1929 (Khandala); May 1917 (Khandala); August 1895 (Karwar); August 1918 (Dandeli); August 11, 1929 (Mulland); August 25, 1929 (Sion); September (Lonavla); September 1892 (Godhra); September 1914 (Wadaj); September 1919 (Khandala); September 1917 (Bombay, Alnavar); September 10, 1883 (Yellapur); September 15, 1929 (Borivli to Kanari Caves); September 20, 1902 (Khandala); October 1914 (Sonasan); October 1919 (Yellapur, Hattikeri); November 1, 1910 (Sanikalta); November 12, 1907 (Bhusi); December 1916 (Bor); December 9, 1902 (between Nadsur and Pali).

Field notes: A monsoon and marsh species; during the dry weather usually found in soft sticky soil. Forming small tufts of a number of plants growing together in one mass.

In plants growing in marshes during the hot weather we have noticed the entire plant, including the inflorescence, quite green, but in monsoon specimens outside true marshes we have noticed the inflorescence straw coloured. In the northern parts of the Presidency this species is common in the sandy and stony beds of streams.

A species easily overlooked during the hot weather on account of the uniform green colouring. The best specimens are obtained in soft mud during the monsoon.

With the exception of the marsh examples which flower the year round, this species commences to flower in early August.

We cannot agree with Sedgwick that this plant is the commonest plant on sandy places as it is equally common in thick sticky soil in marshes and even in water. At Khandala particularly, it is extremely common in the marsh between the railway station and the Parsi Sanatorium. Here it is quite green —the whole plant—and is easily overlooked for a *Cyperus* with only leaves, particularly in its dwarf state. In the same marsh it is to be found right through the dry weather. Specimens taken on sandy soil were certainly taller than those from the marsh. Where the marsh specimens lost in size they made up in roots, as the roots in these specimens were much more elaborate than in those obtained in sandy situations.

Distribution: Throughout India.—Ceylon, Malaya, China, tropical Africa and Australia.

3. Juncellus C. B. Clarke.

Stems erect, leafy only near the base. Leaves rarely reduced to sheaths; sheaths not inflated. Inflorescence umbellate or capitate. Spikelets compressed; rhachilla persistent. Glumes distichous, concave, the 2 lowest empty, the uppermost 1-3 sterile or empty, the intermediate bisexual. Stamens 3 or 2. Style 2-fid. Nut plano-convex, more or less compressed at right angles to the rhachilla.—Species about 20.—In all warm climates.

Of the three *Juncelli* that occur in the Presidency all are very distinct from one another and are easily recognized. *J. alopecuroides* Clarke is perhaps the largest of the three and is liable to be confused with a *Cyperus*, but the rhachilla and nut coupled with the 2-fid style separate it at once from that genus.

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1. A tall stout herb. Spikelets in a large compound umbel	1. *J. alopecuroides*.
2. A dwarf herb. Spikelets close-packed in a small terminal head	2. *J. Michelianus*.
3. A glaucous herb, about 30 cm. high. Spikelets in a small, apparently lateral head ...	3. *J. laevigatus*.

1. **Juncellus alopecuroides** C. B. Clarke in Hook. f. F.B.I. vi (1893) 595.—*Cyperus alopecuroides* Rottb. Descr. *et* Ic. (1773) 38, t. 8, fig. 4; Cke. ii, 860.

Description: Cke. l.c.

Rhizome stout, clothed with black, linear or linear-lanceolate scales, scales striate (dry specimen). Stem up to 140 cm. by 13.5 mm. (at base), enclosed in thick spongy sheaths, striate. Leaves 64 cm. (incomplete) by 15 mm.

Rays up to 7, up to 17.8 cm. (the longest) terminated by about 6 spikelets; secondary rays 4.3 cm. Bracts exceeding 45 cm. by 12 mm., margins scabrous, 5 in number; bracteoles (secondary) at base of each primary ray 45 by 3 mm. at base.

Mr. Bhide remarks 'Style occasionally 3-fid'. Sedgwick also says that the style is sometimes 2-fid and sometimes 3-fid. In specimens examined we have found the style 2-fid and ocasionally 3-fid.

Specimens taken at Shivneri Fort in March are golden in colour, while those taken at other times are a pinkish grey.

Talbot's specimen No. 1064 was determined as *Cyperus exaltatus*, but this specimen is undoubtedly a *Juncellus*. The specimen from Devikope is a very fine example.

Locality: *Sind*: (Stocks ex Cooke); Kullan Kote Lake (Blatter & McCann D711 !); Lake near Tatta (Blatter & McCann D712 !).—*Gujarat*: In standing and running water (ex Saxton & Sedgwick); marshes near Prantij (Sedgwick 283 !); Ahmedabad, Watrak River, rainfall 32 in. (Sedgwick 1061 !); Godhra (Chibber 611 !); Panch Mahals (Woodrow ex Cooke).—*Deccan*: (Woodrow ex Cooke); Patas (Bhide !); Shivneri Fort near Junnar, growing in tanks (Paranjype, several sheets !); between Ellora and Poona (Jacquemont 279 ex Cooke). —*Konkan*: Bombay (Jacquemont 438 ex Cooke).—*S. M. Country*: Alnavar, 2,000 ft., rainfall 35 in. (Sedgwick 2290 !); Devikope (Talbot 1064 !).—*N. Kanara*: Yellapur (Talbot !).

Flowering & fruiting: January 6, 1903 (Patas); February 1917 (Alnavar); March 22, 1911 (Shivneri Fort); May 10, 1912 (Shivneri Fort); August 1914 (near Prantij); August 1916 (Watrak River); September 10, 1911 (Shivneri Fort); November 5, 1884 (Yellapur); December 5, 1907 (Godhra).

Distribution: Throughout India:—Ceylon, Tropical and N. Africa, Mascarene Islands, Malaya, Queensland, Guadeloupe.

2. **Juncellus Michelianus** (Linn.) Blatter & McCann, *comb. nov.*—*Scirpus Michelianus* Linn. Sp. Pl. (1753) 76.—*Isolepis Micheliana* Roem. & Schult. Syst. ii, 114.—*Dichostylis Micheliana* Nees in Wight Contrib. 94.—*Cyperus pygmaeus* Rottb. Descr. *et* Ic. (1773) 20, t. 14, fig. 5; Cke. ii, 859.—*Cyperus pygmaeus* var. β Boeck. in Linnaea xxxv (1868) 494.—*Juncellus pygmaeus* C. B. Clarke in Hook. f. F.B.I. vi (1893) 596.

Description: Cke. l.c. (under *C. pygmaeus*).

The following is a remark by Clarke on a sheet of Kurz (Herb. Sulp. Kurz.): 'Boeckeler has sunk *Isolepis micheliana* into *Cyperus pygmaeus* considering that *Cyperus pygmaeus* has sometimes its axis twisted and the scales hence not bifarious. But besides this difference *Isolepis micheliana* has the glumes imbricate on all sides (of) the axis, the achene is really quite different. In *Isolepis micheliana* the achene has a translucent margin and under the microscope one achene of *Isolepis micheliana* can easily be picked out of a heap of achenes of *Cyperus pygmaeus*.' C. B. Clarke, May 1883.

When working out the *Cyperaceae* of the Bombay Pres. McCann independently arrived at the same conclusion as Boeckeler and remarked the following in his MS.: "I am of opinion that Boeckeler was right in uniting this species (*Juncellus pygmaeus*) with *Scirpus Michelianus*. I find no difference between the 'two': The only distinguishing point according to Clarke is the 'imbricate' spikelets (glumes) in *S. Michelianus* and distichous sp. in *J. pygmaeus*. I have examined all the material available from the Presidency. In the same head are to be found the distichous as well as the 'imbricate' glumes. In all

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cases the lower portion of the spikelet is distichous while the upper portion is imbricate only. 'This is possibly due to the close-set glumes (spikelets) in a dense head causing the rhachilla to twist thus giving the appearance of the glumes being imbricately set on it.' After writing this remark I was able to examine the material at Calcutta all of which was named by C. B. Clarke. I compared the material of both species referred to and could not distinguish one from the other. Even the remarks regarding the nut (as above) do not agree with the reality. I examined several nuts of both 'species' on the same slide and could not distinguish them. I finally mixed them up and not even then could separate one from the other." C. McCann, March 17, 1930.

In the Journ. Bom. Nat. Hist. Soc. vol. xix, p. 162 (Flora of Cutch) there is mentioned in the list *Cyperus pygmaeus* C. B. Clarke. This we take to be this species, viz. *J. pygmaeus* as the authority is evidently wrongly quoted—there is no *C. pygmaeus* named by C. B. Clarke. Clarke transferred *C. pygmaeus* Rottb. to *J. pygmaeus*.

The specimens from Kanheri measure 40 cm. (Cf. Cooke). Judging from the unusual length, these plants must have been growing among other vegetation and in their effort to get to the light the stems have become elongated; the stems are comparatively weak considering the usual habit of the plant.

Locality: Without locality (Dalzell H.E.B.B. !).—*Cutch*: Blatter (ex Journ. Bom. Nat. Hist. Soc.).—*Gujarat*: Kabir Vad (Chibber 765 !, Gammie !); Nadiad (Chibber 248 !); Surat (Woodrow ex Cooke, Gammie 16443 !); Ahmedabad, dry edges of the Chandola tank (Sedgwick !); Sabarmati River, bank (Saxton 2753 !).—*Khandesh*: Bhusawal, Tapti bank (McCann 3034 !, Gammie); Taner, Tapti bank (Blatter & Hallberg 5174 !); Bor, island, Tapti River (Blatter & Hallberg 1862 ! 1925 !); Bori, island, Tapti River (Blatter & Hallberg C97 !).—*W. Ghats*: Khandala (Blatter & McCann 3163 ! 3173 ! 3174 ! 3186 !), in a marsh near station (McCann 379 ! 393 ! 408 ! 409 !).—*Deccan*: Bairawadi, near Purandhar (Blatter & McCann 5611 !); Sangli, river bank (Blatter C95 ! C96 !); in the Katraj tank (Gammie 15226 !); Sholapur, Sideshwar tank (H.E.B.B. !); Poona (Woodrow ex Cooke).—*Konkan*: (Law ex Cooke); Pen (Blatter, Hallberg & McCann 3234 ! 3249 !); Bhandup (Blatter & McCann 2433 !); Uran, Bombay Harbour (Hallberg & McCann 2736 !); Kanheri, Thana Dist. (Gammie 16271 !); Sion (Blatter & McCann 2728 !).—*S. M. Country*: Nigadi, rice fields (Dharwar Dist.), 2,000 ft., rainfall 35 in. (Sedgwick 5710 !); W. of Dharwar, dried rice fields, 2,000 ft., 35 in. (Sedgwick 2207 !); Bagalkot, Bijapur Dist. (H.E.B.B. !).—*N. Kanara*: Nincholi (label illegible, eaten by insects) on river bank (Talbot 946 !).

Flowering & fruiting: January 1917 (Uran); January 21, 1925 (Sangli); February 1917 (W. of Dharwar); February 1917 (Pen); March 1917 (Khandala); March 1919 (Nigadi); April 1929 (Khandala); April 4, 1884 (Nincholi); April 12, 1906 (Sholapur); April 17, 1906 (Bagalkot); May 1914 (Ahmedabad); May 1917 (Khandala); May 8, 1903 (Kanheri); May 28, 1902 (Katraj); June 1917 (Bhandup); October 29, 1903 (Surat); November 25, 1907 (Nadiad); December 1916 (Bor, Bhusawal); December 1917 (Bairawadi); December 10, 1907 (Kabir Vad); December 17, 1921 (Ahmedabad); December 20, 1904 (Kabir Vad); December 21, 1902 (Bhusawal); December 30, 1916 (Taner).

Field notes: A plant generally to be met with near water or damp earth at any time of the year. Boggy or sandy soil is immaterial, but better specimens are certainly developed on sandy situations, particularly on the banks of tanks and streams. Where the specimens inhabiting marshes lose in size, this is made up for by way of roots. On sand the roots are short and few in number compared with those growing in marshes.

'When growing on edges of tanks it flowers when exposed by the subsidence of the water, and right on through the dry season.' (Saxton & Sedgwick).

Distribution: More or less throughout India.—Ceylon, Tropical and N. Africa, Orient, China, Amurland, Malaya and Australia.

3. **Juncellus laevigatus** C. B. Clarke in Hook. f. F.B.I. vi (1893) 596.—*J. laevigatus* var. *junciformis* (Desf.) C. B. Clarke l.c. 597.—*Cyperus junciformis* Desf. Fl. Atlant. i, 42, t. 7, fig. 1.—*C. laevigatus* Linn. Mant. (1771) 179. Cke. ii, 860.

Description: Cke. l.c.

In the Herbarium of the Imperial Forest Institute, Dehra Dun, there is a

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sheet of this species, collected by Dalzell without locality. The whole sheet comprises a single specimen with a long creeping stolon on which both the variety, var. *junciformis*, and the type are represented. The part representing the species is very large—38 cm. with a bunch of spikelets 2 cm. from the top, all of a pale straw colour, or dirty white. There are 13 spikelets, the longest of which is 14 mm. and of about 40 flowers. The sheath ascends the culm for about 10 cm., the latter is 6 mm. thick (but it may not have the diameter when fresh). The variety is represented by single and tufted culms along the stolon. The stems are almost 20 cm. high, thin, with the sheath in some cases reaching almost half way up. The spikes are short and few-flowered, a dark reddish brown in colour. They are from 1-4 in number and about 16-flowered. The apparent continuation of the culm is a little longer in these cases. All the spikelets of the culm representing the variety are all in flower, while those on the culm representing the species are in fruit.

This is very curious and will perhaps enable us to throw some light on other such cases. Under these circumstances the variety must necessarily fall and the characters be added to the description of the species.

We think that the large culm representing the species is a late culm of the wet season form and that those representing the variety are the dry season form. This view is not altogether wrong as the 'type culm' is in fruit and the variety culms are in early flower.

Locality: Without locality (Dalzell, H.I.F.I. !).—*Sind*: (Stocks 751 ex Cooke, Pinwill ex Cooke).—*Kathiawar*: (Woodrow ex Cooke); Ghogho (Herb. Col. of Sc. Poona now in Herb. Calc. !).—*Gujarat*: Ahmedabad (Rep. on Econ. Prod. to Govt. of India 15610 !); nala near Wadaj, Ahmedabad (Sedgwick 300 !, Saxton 2831 !); Kharaghoda (Saxton !); edges of the Bokh, Prantij (Sedgwick 257 !); sandy bed of stream under Gorair Bridge, Chitrasani to Sarotra (McCann 1365 ! 1365a ! 1465b ! 1365c !).—*Khandesh*: Dhulia (Chibber !).—*Deccan*: Nira Canal, Poona Dist. (Chibber !); Happy Valley, Ahmednagar Dist. (Chibber !).—*Konkan*: Bombay, salt marshes (Herb. St. X. C. 3144 !, Woodrow !); salt marshes behind Goods Yard, Bandra (Vakil C127 !).—*S. M. Country*: Hubli, 2,000 ft., rainfall 30 in. (Sedgwick 5081 !); Yelvigi, Dharwar Dist., 1,800 ft., rainfall 25 in. (Sedgwick 1936 !).

Flowering & fruiting: January 1919 (Hubli); February 1919 (Bandra); February 2, 1894 (Ghogho); March 14, 1908 (Nira Canal); August 1914 (Prantij); September 1914 (Wadaj); October 11, 1914 (Kharaghoda); October 24, 1929 (Gorair Bridge); December 1916 (Yelvigi); December 25, 1907 (Happy Valley); December 27, 1907 (Dhulia).

Field notes: A plant of sandy river beds and marsh alike with long far reaching stolons with the culms at intervals, solitary, or many together. Roots appearing along the underside of the stolon. Stolon yellowish to light yellow-brown.

Culms very obtusely 3-gonous, almost terete, a polished bright green.

Spikelets pale green, turning straw coloured (no brown dots in fresh specimens). Rhachilla green (no brown spots). Glumes with 3 distinct green nerves, sides hyaline, margins decurrent into the rhachilla. Stigmas occasionally 3. Anthers yellow with bright red acute tips. Nut green at first, turning straw coloured.

Saxton and Sedgwick found this species in close association with *Paspalum distichum* Linn. and *Panicum punctatum* Burm.

See R. Ranade, *Cyperus laevigatus* as a soil indicator. In Proc. 10th Ind. Sc. Congress (1924) 190.

Distribution: Kashmir, Punjab, Upper Gangetic Plain.—In all warm and temperate regions.

(To be continued).

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SOME BEAUTIFUL INDIAN TREES.

BY

E. BLATTER, S.J., PH.D., F.L.S. and W. S. MILLARD, F.Z.S.

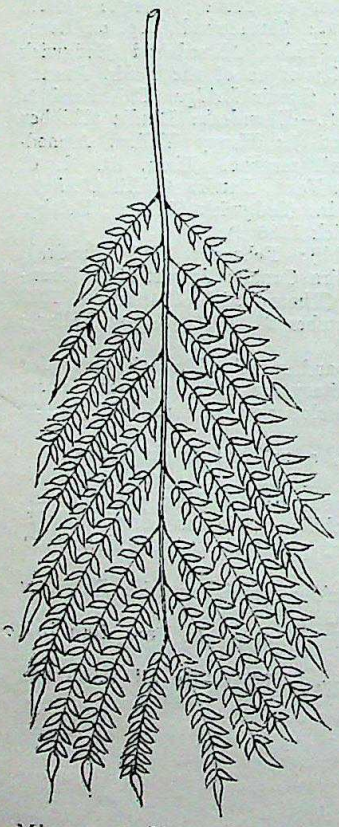
PART XIV.

(*With one coloured plate, one black-and-white plate and two text-figures*).

(*Continued from page* 780 *of volume* XXXVI).

Plate XXII. THE MIMOSA-LEAFED JACARANDA.

Popular names: Jacaranda (Brazilian); Mimosa-leafed Jacaranda.



***Jacaranda mimosaefolia** D. Don in Bot. Reg. (1822) t. 631.—*Jacaranda ovalifolia* R. Br. in Bot. Mag. (1822) t. 2327.—Belongs to the *Bignoniaceae*.

Description: A tree, 50 ft. and more. The foliage is as finely cut as a fern, symmetrical and elegant. The leaves are opposite, distant, each one with 16 or more pairs of pinnae, each pinna having 14-24 pairs of leaflets; leaflets oblong-rhomboid, $\frac{1}{5}$–$\frac{1}{3}$ in. long, the end-one larger. The plant bears loose, pyramidal panicles, 8 in. high, of 40-90 blue flowers, each 2 in. long and $1\frac{1}{2}$ in. wide, which have a long, bent, swelling tube and the 2 lobes of 1 lip smaller than the 3 other lobes. Calyx small, 5-toothed (or in other words: Corolla 2 in. long, the tube slender and curved below, inflated above, the limb 2-lipped, one lip 2-lobed, the other 3-lobed). Perfect stamens 4, 2 long and 2 short; barren stamen (staminode) about as long as the stamens, club-shaped at the tip. Fruit an oblong, ovate or broad dehiscent capsule.

A very beautiful tree with foliage resembling that of the Albizzias or Mimosas. It perhaps ranks among the best flowering trees or shrubs for subtropical and tropical regions.

[1] The name *J. mimosaefolia* must give place to *J. ovalifolia*, which antedates it.—EDS.

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590.5
B63J
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THE MIMOSA-LEAFED JACARANDA.
Jacaranda mimosaefolia, D. Don.
(about ½ nat. size)

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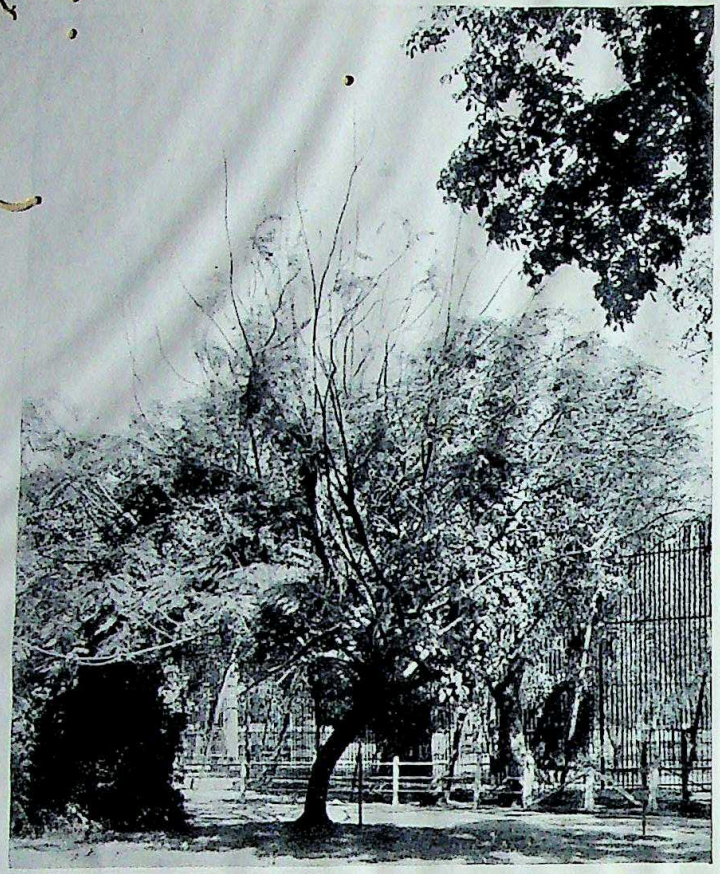
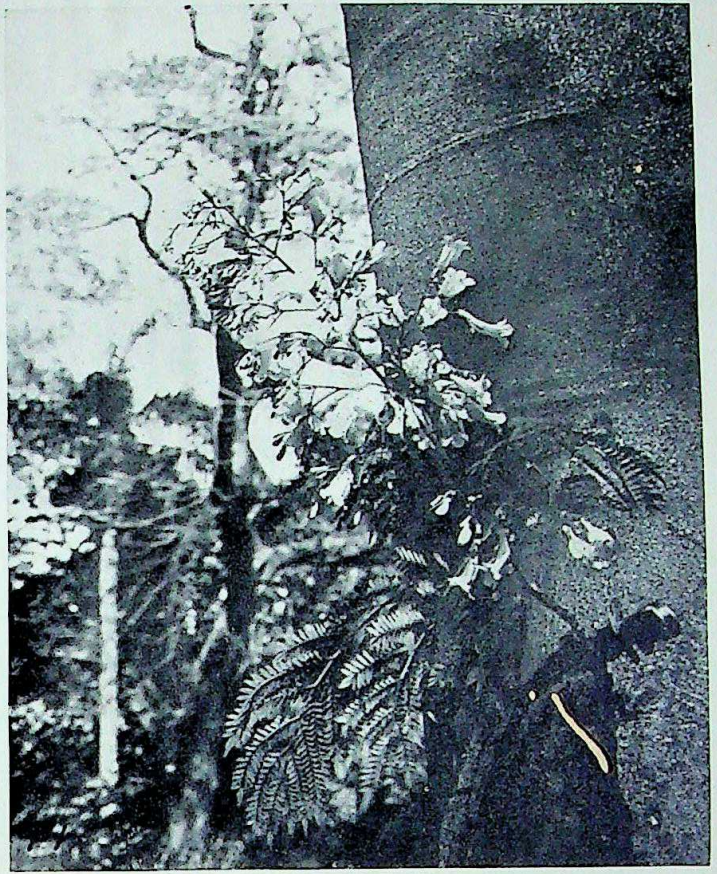


The Mimosa-leafed Jacaranda,
(*Jacaranda mimosaefolia*, D. Don.).



A spray of flowers of the Mimosa-leafed Jacaranda,
(*Jacaranda mimosaefolia*, D. Don.).

Photos by C. McCann.

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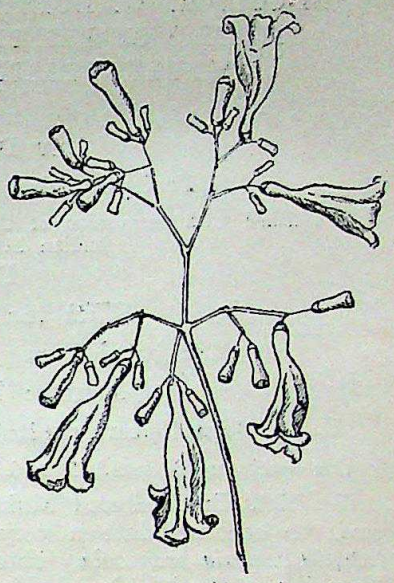
It is a native of Brazil and of somewhat recent introduction, but now becoming common in gardens.

This tree is not common round Bombay and although it does sometimes flower there, the temperature, or perhaps the sea air does not appear to suit it so well as upcountry. At Pachmarhi, C.P., this tree thrives and flowers splendidly as also in Northern India.

The flowers are violet-blue in colour and the tree flowers in March and also at other times.

Gardening: Propagated by cuttings of half-ripened wood. It stands pruning well and can be kept in regular form.



(*To be continued*).

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REPORT ON BURMESE FISHES COLLECTED BY LT.-COL. R. W. BURTON FROM THE TRIBUTARY STREAMS OF THE MALI HKA RIVER OF THE MYITKYINA DISTRICT (UPPER BURMA).[1]

BY

DEV DEV MUKERJI,

Zoological Survey of India, Calcutta.

(Published with permission of the Director, Zoological Survey of India, Indian Museum, Calcutta).

PART II.

(*With text-figures* 4 *to* 14).

(*Continued from page* 831, *volume* XXXVI).

FAMILY: HOMALOPTERIDAE.

Homaloptera rupicola (Prashad & Mukerji).

One specimen (36 mm.) from Phungin Hka: '*Nga Hpai*'.

In 1929 Prashad and Mukerji (45) established the genus *Chopraia* to accommodate a very remarkable form of Homalopterid fish, *Chopraia rupicola*, obtained from the rocky streams of Kamaing in the Myitkyina District in Upper Burma. Despite the form being closely related to the genus *Homaloptera*, the fish had to be given a separate generic position in view of certain distinctive features which, till the time of its discovery, had not been ascribed to the genus *Homaloptera*. In his preliminary observations on the classification of the Homalopterid fishes, Hora (36) recognised the genus *Chopraia* as valid and placed it in the sub-family Homalopterinae. Later, in his monographic revision of the Homalopterid fishes he (37) studied them in greater detail and defined the various generic and specific limits. His extensive studies of these fishes, including certain types preserved in different museums in England and in other countries, enabled him rightly to delimit the various genera and species. Of the genera of the family Homalopteridae *Homaloptera* embraces a vast majority of remarkable torrential fishes with similar or diverse adaptive modifications. Hora's collective survey of the whole group of these fishes justified his considerably extending the generic limit of *Homaloptera;* and *Chopraia* should now be considered a synonym of *Homaloptera* as emended by Hora.

The specimen under report agrees almost entirely with the specimens from the type-locality. The interorbital width is nearly equal to the diameter of the eyes. The pectoral fins reach the ventrals which are shorter than the former.

One important feature of *Homaloptera rupicola*, to which atten-

[1] Mr. Mukerji's paper was published in two parts because of the need of keeping down the number of pages in the *Journal*. The author was unaware of this arrangement by the Editors; hence several citations to the bibliography which is published at the end of the present part were made in Part I and again references will be found in the present part to plates Nos. I-III which were published with Part I in volume XXXVI.—EDS.

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tion has so far not been paid, is that the anterior portion of the ventral surface up to the base of the ventral fins is perfectly horizontal and this area is either devoid of scales or the scales are rudimentary. The flat and the naked ventral surface, the *Balitora*-like horizontal position of the pectoral fins, and the general facies of the fish clearly indicate that the fish is an inhabitant of the rapids. The occurrence of the species in the Phungin Hka seems to be rather unusual, and the specimen may have drifted into the river from some of the rocky streams which abound in the neighbourhood.

FAMILY: COBITIDAE.

Botia hymenophysa (Bleek.).

One specimen (100 mm.) from Sinan Hka: '*Nga-shaba*'.
One specimen (98 mm.) from Tang Hka: '*Nga-pasi*'.

Hora (26) has already discussed at some length the affinities of *Botia berdmorei* of Blyth with *B. hymenophysa* of Bleeker and has considered them conspecific. I have also gone into the question and after a thorough re-examination of the specimens of the two species preserved in the collection of the Indian Museum I agree that *B. berdmorei* is the same as *B. hymenophysa*. The species is extremely variable in regard to the colour pattern, the position of the anal opening and the different body proportions at different stages of its growth and in specimens from different localities.

The two well-preserved specimens from the Mali Hka system have more or less the same colouration as that of *B. berdmorei* figured by Day in his *Fishes of India*. There are from 11 to 12 broad vertical black bands along the sides which pass over the back and join the corresponding ones on the other side. Series of fine black specks and dots are arranged more or less longitudinally all over the body. The dorsal fin is variegated with black bands and blotches. The caudal fin is clouded all over with black dots; it is devoid of any band. A few blackish dots are present on the anal fin also. The rostral barbels are black.

Nemachilus botia (Ham. Buch.) *sensu stricto*.

(Pl. I, fig. 1; Pl. III, figs. 3 & 4).

Two specimens (102 and 73 mm.) from Tang Hka: '*Sumbrun*'.
Two specimens, (88 and 85 mm.) from Tang Hka: '*Sumbrum Chang*'.
One specimen (81 mm.) from Tang Hka: '*Taretu*'.
One specimen (63 mm.) from Phungin Hka: '*Nga Kalang*'.

In his revision of the fishes of the genus *Nemachilus* from Burma, Hora (33) has rightly pointed out that "many of the species of the genus exhibit considerable individual variability"; and so far as I can judge, *N. botia* is perhaps one of the most variable species. It is due chiefly, if not entirely, to the extreme variability of the species that its precise limits have not so far been properly understood and defined, and this has been responsible for considerable misapprehensions. Specimens of *N. botia* have often been erroneously considered to represent a different and distinct species, while others of an allied but distinct species have been referred to *N. botia*. In this connection mention should be made of *N. nebulosa* (Blyth), the short history of which, given below, clearly shows how baffling at times may be the identity of *N. botia*.

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In 1860, Blyth (3) described a new Cobitid fish from a single specimen obtained from Darjiling and presented by Dr. Wallich, under the denomination *Botia nebulosa*. He considered the form to be closely allied to "*B. grandis* but with face shorter (as described) and eight cirri not quite so strongly developed". Günther, apparently due to having no access to the type-specimen of *B. nebulosa*, which was deposited and is still preserved in the collection of the Indian Museum, did not include *B. nebulosa* in the synopsis of the various species of the genus *Botia* in his *Catalogue* (19); but he referred to the species in a foot-note (p. 366) without any comments. In 1869, Day (10) examined the type-specimen and published a short account of *B. nebulosa*. He remarked that "a bifid erectile (damaged) suborbital spine" is present. Later, in his *Monograph of the Indian Cyprinidae* he (11) included a short description of the loach without any fresh comments. Both in his *Fishes of India* and in the *Fauna* volume, Day retained the species *B. nebulosa*, and emphasized in a foot-note (p. 606) that the "suborbital spine was damaged in the unique example". The species did not receive further attention till 1922, when in his revision of the fishes of the genus *Botia*, Hora (26) remarked that "On examination I am unable to refer it (*Botia nebulosa*) to the genus *Botia*. I believe that it belongs to *Nemachilus* and in all probability is a male of *N. botius*". Hora gave sufficient reasons for considering *B. nebulosa* to be a *Nemachilus* and pointed out that Day's contention regarding the suborbital spine being damaged in the type-specimen was rather far-fetched, for, "the groove that is present is not sufficiently deep to justify the view that it ever contained a spine. The groove is of the nature of a shallow slit partly covered superiorly by a fold of skin. I have already remarked in a previous paper that such grooves and folds of skin form the secondary sexual characters of certain species of *Nemachilus*". Owing to the paucity of adequate material of *N. botia* for comparison, it was, however, not possible for Hora to go into further details about the systematic position of *B. nebulosa*.

I have thoroughly examined the five specimens under report from the Mali river system and compared them with the specimens of *N. botia* obtained from different places of India and Burma and referred to by Hora in his revision of the genus, and I find that my specimens are referrable to *N. botia*. Recently Messrs. G. E. Shaw and E. O. Shebbeare have collected abundant material of *N. botia* from various streams and rivers of Northern Bengal, and have presented a fine series of them to the Indian Museum. I have examined these specimens and after comparing the type-specimen of *Botia nebulosa* with all the specimens of *N. botia* now at my disposal, I am thoroughly convinced that *B. nebulosa* is not only not a *Botia* but it is an absolute synonym of *N. botia*, of which almost all the adult males are provided with a suborbital groove, and that the presence of a spine in the suborbital groove of the type-specimen of the former was purely conjectural on the part of the earlier authors.

It may not be out of place to mention in this connection that recently Deraniyagala (17) has reported the typical form of *N. botia*

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under the name *Nemacheilus botia botia* (Ham. Buch.) "from several small streams" in Ceylon. From his description of the fish and the figure it appears that the Ceylonese fish is strikingly allied to *N. botia;* but the fact that the typical form of the species has not so far been known to occur anywhere in Peninsular India, much less in Ceylon, throws a doubt on the accuracy of the specific position of the Ceylonese loach. Moreover, it is quite conceivable that similar environmental conditions may tend to produce similar characters, and that the great resemblance between *N. botia* of India and the one of Ceylon may be due to a similarity in their environments. In the absence of any specimen of Ceylonese *N. botia* for comparative study, it is, however, impossible to judge its affinities. It may yet be pointed out that according to Deraniyagala the base of the dorsal fin of the Ceylonese *N. botia* is "as long as head or pectorals, which latter usually reach ventrals" (p. 38). In all the Indian and the Burmese specimens that I have examined, the base of the dorsal is certainly almost as long as the head or the pectorals, but the pectorals which are invariably shorter than the head hardly reach the ventrals.

From the foregoing account it is quite clear that a certain amount of confusion centres round the true identity of *N. botia.* The species, as it is understood in the present state of our knowledge, is widely distributed in the Indian and the Burmese waters. Below I have given, for future reference, a more or less detailed description of the species from materials from India and Burma. In view of the fact that no adequate figure of the loach has so far been published I take this opportunity to give figures from a well-preserved specimen from the Mali Hka system.

D. 3/11; A. 3/5; P. 1/11; V. 1/7; C. 18 (excluding the small compact outer rays).

The dorsal profile rises from the tip of the snout to the insertion of the dorsal fin with a sudden rise above the orbit. Behind the origin of the dorsal, the outline slopes down slowly, falls appreciably just beyond and below the end of the dorsal base, and then rises up again to the root of the caudal fin. The ventral profile is uniformly and faintly convex. The body is of rather stout build, spindle-shaped and compressed from side to side. It is thinnest at the caudal peduncle, which is squarish in shape and slightly higher than long. The greatest depth of the body is contained from 4.5 to about 5.2 times in the length of the body without the caudal fin. The head is moderate, its length being contained approximately from 4.2 to 4.5 times in the length of the body. It is slightly broader than high. The snout is prominent and somewhat blunt anteriorly. Its length is contained about 2.5 times in the length of the head. The eyes are rather large, placed high and nearer to the angle of the operculum than the tip of the snout. In some grown-up individuals they may be situated almost in the middle of the head. They are scarcely visible from the ventral surface. The orbital width is contained approximately from 3.8 to 5 times in the length of the head. The interorbital space is flat to faintly concave and is almost equal to or slightly narrower than

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the diameter of the eyes. In front of and below the orbit on either side is a transverse subcutaneous ridge-like prominence. Usually there is no definite groove below the ridge, but in case of most adult male specimens a moderately deep groove is discernible. The nostrils are situated nearer the anterior margin of the orbit than the tip of the snout. The anterior ones are provided with well-developed tubular flaps. The mouth is sub-inferior, moderate and horse-shoe-shaped. The lips are rather fleshy and continuous at the angles of the mouth. The upper lip is provided with a few rows of small fleshy papillae, while the lower one has two rounded, raised cushion-like clusters of similar papillae situated centrally. The lower lip is interrupted in the middle. Both the lips are capable of being partly everted off from the jaws. The upper jaw is slightly longer than the lower and partly overhangs it. Both the jaws are provided with thin and sharp horny edges. The upper one is in the form of a small beak, while the lower one is shovel-shaped with a faint symphysial emargination to receive the upper jaw.[1] The gill openings are in the form of vertical slits extending below the insertions of the pectoral fins. There are two rostral and one maxillary pairs of barbels which are fairly well-developed. All the barbels are much longer than the orbital width.

Usually the insertion of the dorsal fin is much nearer the tip of the snout than the base of the caudal fin, but in some specimens, irrespective of age and locality, it may be situated almost in the middle of the same two points. It is long and in most cases longer than high. The length of its base is equal to that of the head or slightly shorter. Its outer margin is straight and oblique. The paired fins are inserted sub-horizontally. The pectorals are generally shorter than the head and are separated from the origin of the ventrals by a variable distance. The ventrals are situated almost vertically below the middle of the dorsal fin and are shorter than the pectorals. They are separated from the commencement of the anal by a considerable distance. The anal fin is short and when laid flat reaches the base of the caudal or just misses it. The pectorals, ventrals and the anal fins have rounded outer margins. The caudal fin is as long as, or a little longer or shorter than the head. It is longer than high, and faintly emarginate, with somewhat rounded lobes. The anal opening is variable in position, but in most cases it is situated almost midway between the tip of the ventrals and the origin of the anal fin.

The scales are of small to moderate size, conspicuous and imbricate. They are absent on the head and considerably reduced on the chest. The lateral line is generally complete, but in some cases it may be incomplete, not extending beyond the anal fin.

The colouration of the species is very variable, and not unlike most of the other loaches, it depends on the nature of the water

[1] So far as I am aware, such characters of the jaws are found more pronounced in the fast stream-dwelling species of the genus *Nemachilus*. In such habitats as the fish feed almost entirely by scraping and rasping off algae and other organic matters from the rocky substratum, such modifications of the jaws are of the utmost utility.

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and other environmental conditions. Ordinarily, the ground-colour is pale olivaceous to yellowish orange with 12 to 16 blackish cross-bars of various turns and twists, descending a little below the level of the lateral line. These bands are generally uninterrupted in the young and half-grown specimens, while in adults they may be broken up into patches, scattered irregularly on the sides. A narrow dark band joins the tip of the snout and the anterior margin of the eyes. Another similar band is present dorsally between the eyes. A prominent black ocellus is usually to be found on the upper base of the caudal fin. All the barbels are dusky, excepting the maxillaries which are white. The fins are yellowish. The dorsal has 5 to 6 oblique, zigzag narrow blackish bands, while the caudal is provided with 5 to 7 posteriorly directed V-shaped dark bands.

Measurements in millimetres:

	Northern Bengal			Mali Hka System		
Length of body without caudal.	70·0	57·0	50·0	102·0	88·0	63·0
Height of body	15·0	12·5	10·0	18·0	18·0	12·0
Length of head	16·0	13·0	11·5	21·0	19·5	14·0
Breadth of head	11·0	9·0	7·0	18·0	13·0	10·5
Height of head	10·0	8·0	7·0	14·0	11·5	9·0
Length of snout	7·0	5·0	4·0	10·0	7·0	6·0
Diameter of eye	3·5	3·0	3·0	4·0	4·0	3·0
Interorbital width	3·0	3·0	2·0	4·5	3·5	3·0
Height of dorsal fin ...	15·5	13·0	12·0	19·0	18·5	12·0
Length of pectoral fin ...	15·0	12·0	11·0	18·0	16·0	11·5
Length of ventral fin ...	11·5	9·5	9·0	17·0	14·0	17·0
Length of anal fin	11·5	8·0	8·5	17·0	13·5	11·0
Length of caudal fin ...	16·0	13·0	11·0	22·0	18·5	13·0
Length of caudal peduncle ...	8·0	6·0	6·0	12·0	10·5	7·0
Least height of caudal peduncle	10·0	8·0	7·0	14·5	13·0	9·0

Nemachilus paucifasciatus Hora.

One specimen (51 mm.) from Phungin Hka: *'Nga Samwiyit'*.

In 1929, Hora (33) described this species from 15 specimens obtained by Dr. J. Coggin Brown from Hwe-gna-sang river in the Hsipaw State of the Northern Shan States. The single specimen collected from the tributary of the Mali river, which I assign to *N. paucifasciatus*, does not differ from the description and figure of the species excepting that the inner rostral barbels do not extend "as far as the nasal opening". They are much shorter, and the outer rostrals, instead of being extended to "below the middle of the eyes" reach only to the nasal opening.

Nemachilus multifasciatus Day *sensu lato*.

One specimen (50 mm.) from Phungin Hka: *'Sambrun'*.

In his *Fishes of India*, Day described this species from "Darjeeling and Assam"[1] and published an illustration of the fish from

[1] Dr. S. L. Hora kindly informs me that during his visit to Europe he had examined a specimen (No. '89.2.1.1669') in the collections of the British Museum (Nat. Hist.) which is labelled in Day's hand-writing as *Nemachilus multifasciatus*. The specimen was collected by Day from Assam.

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a specimen from Darjiling (pl. cliii, fig. 7). In 1889, Vinciguerra (53) reported the species from 'Meekalan' and 'Thagata Juva' near Moulmien in Burma. In his revision of the fishes of the genus *Nemachilus* from Burma, Hora (33) briefly observed that Vinciguerra's specimens from Burma have, in all probability been wrongly referred to *N. multifasciatus* and that the fish "appears to represent a new species". Unfortunately, the unique type-specimen of *N. multifasciatus* from Darjiling which is still preserved in the collection of the Indian Museum is in such a state of maceration that it has become useless for all taxonomic purposes. Moreover, the species seems to be so very rare that since Day's discovery it has not been, leaving aside Vinciguerra's record from Burma, reported again from the Darjiling Himalayas or the adjoining areas, although fairly extensive collections of similar fishes have been made in these areas from time to time by parties of the Zoological Survey of India, and very recently by Messrs. G. E. Shaw and E. O. Shebbeare. Day's descriptions and figures of *Fishes of India*, in general, have been found to be so indefinite and inaccurate that it is often impossible to judge the precise limits of a species without having fresh specimens from the type-locality as a check. Under these circumstances nothing can be said definitely in regard to the specific limits of Day's *N. multifasciatus*, and the fish must be understood and shall remain provisionally known from whatever descriptive accounts it has to its credit until such time as the typical form is again obtained and definitely studied. It seems justifiable, therefore, to make reasonable allowance, so far as this fish is concerned, for minor differences in body proportions and colouration, etc., rather than to consider these as differentiating characters.

Sometime ago, Dr. D. Vinciguerra of the Genova Museum kindly presented a specimen of his Burmese *N. multifasciatus* to the Indian Museum. I have thoroughly examined the specimen and I am in agreement with Hora's view that the fish, judging it by Day's description of *N. multifasciatus*, appears to be new, differing from the latter chiefly in certain body proportions. But in view of what has already been said about the merit of Day's accounts and of the well-known plasticity of shape and structure under variable environmental conditions, of the stream-dwelling loaches in general, I do not propose to separate the Burmese *N. multifasciatus* from the one of India. As for the difference in colouration of the Burmese form, it is to be regarded as no more than a racial character, for, it is well known that most of the freshwater fishes of Burma have a characteristic brilliance of colouration.

In Colonel Burton's collections from the Mali Hka system there is a single specimen which is inseparable from Vinciguerra's specimen from 'Meekalan', although it differs somewhat in colouration.

Quite recently, Dr. H. M. Smith, of the Fisheries Department, Bangkok, Siam, collected several specimens of a species of *Nemachilus* from Northern Siam and sent a fine series to Dr. S. L. Hora for study and opinion. In forwarding the specimens Dr. Smith wrote that the fish "seems to be close to *multifasciatus*. It agrees in (1) very short barbels, (2) short pectorals,

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(3) shape of caudal, (4) complete lateral line, (5) black bar at base of caudal and (6) general colouration, but (1) is more slender and (2) colouration of fins different". Having examined these Siamese specimens and after comparing them with Vinciguerra's form Dr. Hora informed Dr. Smith in a letter that the Siamese fish "is undoubtedly *N. multifasciatus* of Vinciguerra (but not of Day)" and that "Vinciguerra's *N. multifasciatus* appears to represent a new species", of which he already had a description written and an illustration made with a view to publish them under a new specific name.

I have also examined the same Siamese specimens, temporarily retained in the Indian Museum for study, and find that they are indistinguishable both from the 'Meekalan' specimen and the one from the Phungin Hka tributary of the Mali river under report and that all these specimens should be referred to one species. But as to whether they are referable to Day's *N. multifasciatus* or to a new species appears to be only a matter of opinion. In the present state of our knowledge of the fish in question, I am personally inclined to refer both the Burmese and the Siamese forms to *N. multifasciatus*. In case it is proved by future studies, based on adequate material, that the typical form of Day's *N. multifasciatus* is specifically distinct from the Burmese and the Siamese forms, the latter may be ranked as a separate species and the following description of the fish from the data before me as also the figure of the 'Meekalan' specimen to be published elsewhere by Dr. Hora will be of help in understanding the affinities of these fishes.

D. 3/8; A. 3/5; P. 1/11; V. 1/7; C. 19 (excluding small compact outer rays).

The profile in front of the dorsal fin is moderately arched, beyond which it is almost straight or a little sloping to the root of the caudal fin. The ventral profile is more or less horizontal or very slightly convex. The body is of a rather slender build, elongated and narrow. It is somewhat compressed from side to side, being thinnest at the posterior end of the caudal peduncle, which is squarish in shape and invariably as long as high. The utmost height of the body is contained from 5.5 to 6.5 times in the total length without the caudal fin. The head is short and a little broader than high; its length is contained from 4.8 to 5.2 times in the length of the body. The snout is moderate and pointed anteriorly. Its length is contained from 2.5 to 3 times in the length of the head. The eyes are small and situated almost in the middle of the distance between the tip of the snout and the angle of the operculum. They are not visible from the ventral surface. The orbital width is contained from 4 to 5.4 times in the length of the head. The interorbital space is usually slightly convex, but in certain adult specimens it may be almost flat. It is generally narrower than the diameter of the eyes. The nostrils are situated much nearer the anterior margin of the orbit than the tip of the snout. They are partitioned by a moderate and thin flap.

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The mouth is sub-inferior, arched and of moderate size. The upper jaw is slightly longer than the lower one, and partly overhangs the latter. Both the jaws have sharp horny edges. The upper one is in the form of a small beak, while the lower is somewhat shovel-shaped with a symphysial emargination to receive the beak of the upper jaw. The upper lip is rather short and thin. The lower one is better developed and has faint longitudinal striations in the middle. The lips are continuous at the angles of the mouth. The upper one is capable of being partly everted off the jaw. The lower one is moderately united to the isthmus. The gill-openings are in the form of slightly curved slits, extending from the insertion of the lateral line to below the bases of the pectorals. There are three pairs of short barbels. The outer rostrals are slightly longer than the inner, but are almost equal to the maxillaries.

The dorsal fin is inserted midway between the tip of the snout and the base of the caudal fin or just a little nearer to the former. It is shorter than high, the length of its base being almost equal to the length of the head behind the nostrils; its height is slightly less than the depth of the body below it. The outer margin is straight or very slightly curved. The paired fins are placed subhorizontally. The pectorals are generally shorter but in some specimens they may be equal to or even a little longer than the head. They are separated from the origin of the ventrals by a distance equalling about half their own length. The ventrals are situated vertically below or a little behind the origin of the dorsal. They are shorter than the pectorals and are separated from the commencement of the anal by a variable distance. They invariably reach as far as the anal opening, which is situated much nearer the origin of the anal than that of the ventrals. The outer margins of the paired fins are somewhat rounded. The anal fin is short and when laid flat it may almost reach the root of the caudal or may be separated from it by a short space. The caudal fin is usually longer than the head, but in some specimens it may be of equal length. It is longer than high and moderately emarginate with more or less equal and blunt lobes.

The scales are rather small and imbricate, but are not inconspicuous. They are more prominent on the posterior half of the body. The head and the chest are without scales. The lateral line is complete.

In regard to the colouration of *N. multifasciatus*, Day (14) observed that "vertical bands as wide as the ground colour pass from the back to the lower surface of the abdomen, *those between the head and the dorsal fin are numerous*, whilst there are about five posterior to it. *In some examples these anterior bands coalesce. A dark band at the base of the caudal* and dark marks on the head radiating from the eye. Fins yellow, the dorsal with four bands of spots and an equal number or more on the caudal. Ventral and anal with two bands each". (Italics are mine.). I find that the colouration of the Burmese and the Siamese specimens does not differ much from Day's description except for the number and the nature of the bands on the body and on the fins. In

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most specimens the colouration of the different fins is lost in alcohol. In a couple of specimens from Siam, however, I find two distinct blackish bands on the dorsal and two on the caudal fin. Both the ventrals and the anal fins have a faint and narrow band. The characteristic dark band at the root of the caudal fin is present in all the specimens.

Remarks: From the present data it may be inferred that *N. multifasciatus* is more common in Burma and in Northern Siam than in the Eastern Himalayas, and that in all probability it is essentially a species of the Burmese and the Siamese waters, its range extending from these areas through Assam to the Darjiling Himalayas. Under normal circumstances, the density of population of a species of fish in any area is found to be inversely proportional to the distance between the centre of distribution and the area concerned. The extreme rarity of the species in the Eastern Himalayas and particularly in the neighbourhood of Darjiling, where fairly extensive collections have been made, seems to corroborate this view.

Measurements in millimetres.

	Meekalan	Phungin Hka	Northern Siam		
Length of body without caudal ...	52·0	50·0	66·0	48·0	36·0
Height of body	8·5	8·0	10·0	8·0	6·5
Length of head	10·0	10·0	13·5	10·0	7·5
Breadth of head	7·5	7·0	9·0	6·5	5·0
Height of head	6·0	5·5	7·0	5·0	4·0
Length of snout	4·0	4 0	4·5	4·0	2·5
Diameter of eye	2·5	2·0	2·5	2·0	1·5
Interorbital width	1·5	1·5	2·5	1·5	1·0
Height of dorsal fin	9·5	9·0	13·0	8·0	7·0
Length of pectoral fin ...	11·5	8·5	13·0	8·0	7·0
Length of ventral fin ...	10·0	8·0	11·5	8·0	6·0
Length of anal fin	18·0	17·0	10·5	17·5	6·0
Length of caudal fin	12·0	11·0	15·5	10·0	7·5
Length of caudal peduncle ...	6·0	7·0	9·5	7·0	4·5
Least height of caudal peduncle.	6·0	6·5	9·0	6·0	4·5

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Nemachilus kangjupkhulensis Hora.

One specimen (48 mm.) from Tang Hka: *'Zaibru Htu'*.

The species was discovered by Hora (23) in 1921 from the hill-streams of the Manipur Valley where it is said to be "widely distributed". The single specimen from the Tang Hka tributary of the Mali river, which I assign to this species, does not appear to differ in any essential feature from the description of the fish given by Hora or from the type-specimen which I have examined. The colouration of the Burmese specimen is partly lost in alcohol, but it seems to correspond almost entirely to that of the Assamese individuals. The lateral line extends to the commencement of the ventral fins.

The species is recorded here for the first time from Burma.

FAMILY: CYPRINIDAE.

Genus: **Garra** Hamilton Buchanan.

When urging the revival of the oldest available generic names Jordan (39) pointed out that Hamilton Buchanan's *Garra* (1822) is a valid genus and it replaces *Discognathus* Heckel (1842). In his elaborate studies of the fishes of the genus *Garra*, Hora (24) discussed the matter in detail and stressed the validity of the genus *Garra* and pointed out its relationships with the allied genera. This removed the confusion that till then obscured the true status of the names *Garra* and *Discognathus;* and it was due entirely to this confusion that an indiscriminate use of both the names *Garra* and *Discognathus* found place in ichthyological literature. It is unfortunate, however, that some ichthyologists still uphold the name *Discognathus*, which despite its being more significant and suitable for the disc-mouthed fishes than *Garra*, has no nomenclatural status.

Bleeker (2) divided the genus *Garra* into two groups *viz.*, *Garra* and *Discognathus* according as the fish have four or two barbels. Subsequently, Garman (18) suggested a third group for such forms as *G. imberbis* Vinciguerra in which the barbels are absent. He called it *Agenciogarra*. It appears to me far too artificial and quite unnecessary to split the genus *Garra* into three subgenera on the character of the barbels alone. It is a well known fact that barbels are very variable structures, specially among Cyprinoid fishes. Recently, Rendahl (49), however, has recognised these subgeneric divisions.

Garra lamta (Ham. Buch.) *sensu lato*.

One specimen (116 mm.) from Phungin Kha: *'Wuh tang'*, 'Bulldog mouth'.

The proboscis is trilobed (Text-fig. 4). The central lobe is flat dorso-ventrally and occupies the greater portion of the snout. The

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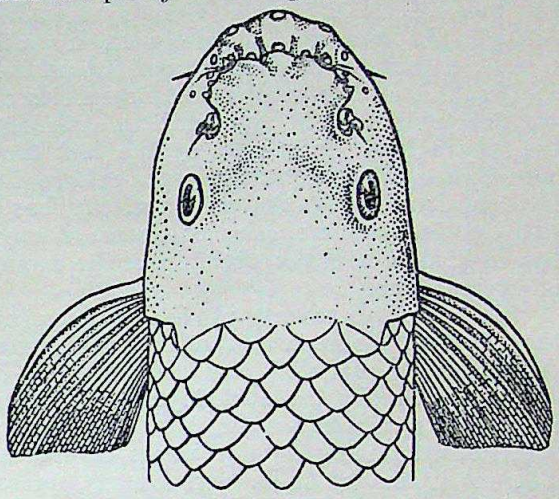
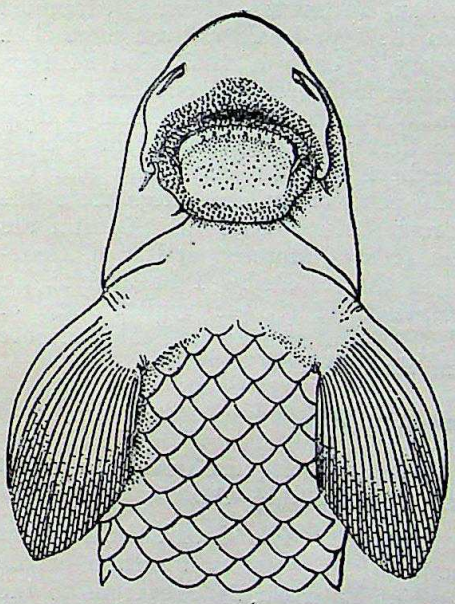
lateral lobes are small and are partly overhung by the central lobe. A deep groove marks off the tip of the snout. The anterior portion of all the lobes and the tip of the snout are covered with sharp spiny tubercles. The eyes are dorso-lateral in position and are placed wholly in the posterior half of the head.

I have compared the specimen from the Phungin Hka with one of Vinciguerra's *G. lamta* (53) from 'Meekalan' in Burma and have found that the specimens agree in every detail except for the proboscis, which is bilobed in the Meekalan specimen.



Text-fig. 4.—Dorsal view of the anterior portion of the head and body of *Garra lamta* (Ham. Buch.) from the Mali Hka system showing the nature of the proboscis and the tubercles on the snout, ×1½.



Text-fig. 5.—Ventral view of the anterior portion of the head and body of *G. lamta* showing the nature of the mouth, the lips and the suctorial disc, ×1½.

Remarks: I provisionally refer the specimen under report to this species as it cannot be reconciled with any other known species of the genus found within the limits of the Indian Empire. Moreover, it has a closer affinity with *G. lamta* than with any other species. *G. lamta* has so far been considered as a composite form. When, however, Buchanan's (20) typical '*Cyprinus* (*Garra*) *lamta*' has been properly understood and defined this form as well as Vinciguerra's *G. lamta* from Meekalan may turn out to be a new species.

Crossochilus latius
(Ham. Buch.).

Two specimens (109 and 119 mm.) from Phungin Hka: '*Nga Lum*'.

The species was originally described by Hamilton

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Buchanan in his *Gangetic Fishes* (20) from the "Tista" river at the base of the Darjiling Himalayas under the name '*Cyprinus latius*'. He placed the species in his 9th Division,—'*Cyprinus Garra*', because of certain morphological features and habits that the fish has in common with some species of *Garra*. That Buchanan was not far from the truth in considering *C. latius* a fish of the 'Garra kind" is proved by the fact that later researches have led most authors tentatively to believe that *Garra* has evolved from a *Crossochilus*-like ancestor. It has been shown by Hora (24) that in certain species of *Garra*, at any rate, the structure of the air-bladder and the skeleton of the mouth-parts resemble those of *Crossochilus*.

Since the discovery of the species from Northern Bengal, the range of its distribution has been extended to "Nepaul and Assam" (11) and to "Sind, Orissa, N.-W. Provinces, Punjab, Deccan and along the Himalayas" (14). In 1890, the species was recorded for the first time from Burma by Vinciguerra (53).

After examining a large series of specimens of *C. latius* from different places of India and Burma, preserved in the collection of the Indian Museum, I indicated in an earlier paper (42) that "the species is very variable in respect of the shape of the head and the body and the lepidosis". But in the absence of any specimens from the type-locality it was not possible for me to go into greater details. Quite recently, however, Messrs. G. E. Shaw and E. O. Shebbeare have collected a fine series of *C. latius* from streams and rivers below Darjiling and have kindly presented several well-preserved specimens to the Indian Museum. Having examined these specimens, practically from the type-locality, I am more than ever convinced that it is necessary to draw a distinction between the group of individuals of *C. latius* found, on the one hand, along the Eastern Himalayas, *i.e.* in Northern Bengal, Assam and in Burma, and, on the other, those that are distributed in the Punjab and the N.-W. Provinces. Furthermore, the Assamese and the Burmese forms differ in certain noteworthy characters from the typical form. No specimens from Orissa, Sind and Deccan are available for examination at the present moment and it is, therefore, not possible to comment on them. Below I have given for future reference detailed descriptions of (i) the typical form of *C. latius* from Northern Bengal, (ii) the Assamese and the Burmese form and (iii) of the form from the Punjab.

Forma typica :

D. 3/8; A. 2/5; P. 1/13; V. 1/8; C. 18 (excluding the small compact outer rays); L. l. 37-42; L. tr. 10 ($5\frac{1}{2}/4\frac{1}{2}$).

The body is more or less elongate. The dorsal profile rises slowly from the tip of the snout to the point of insertion of the dorsal fin, beyond and behind which it gradually converges to the root of the caudal fin. The ventral outline is horizontal or slightly curved. The head is small, flat and compressed, and resembles that of *Garra*. It is considerably longer than broad and almost as broad as deep. Its length is contained from 5 to 5.2 times in

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the length of the body without the caudal fin. The snout is very prominent, obtusely pointed, smooth, and overhanging the mouth. Its length is contained from 2.2 to 2.4 times in the length of the head. The eyes are fairly large and situated nearer the angle of the operculum than the tip of the snout. They are not easily visible from the ventral surface. The orbital width is contained from 3.6 to 3.7 times in the length of the head. The interorbital space is rather wide and convex and is much wider than the diameter of the eyes. The nostrils are situated nearer the anterior margin of the eyes than the tip of the snout. The gill-openings are moderate, extending from the anterior point of insertion of the lateral line to a short distance below the base of the pectorals. They are broadly attached to the isthmus.

The mouth is inferior and its opening is slightly arched. The upper lip is in the form of a fairly broad and crenulated fold overhanging the vestibulum of the mouth. Numerous round and soft papillae are arranged more or less regularly towards its free border. The lower lip forms a median, elevated and fleshy area slightly arched anteriorly. It is not separated from the isthmus and is covered at its anterior border with papillae similar to those of the upper lip. There is no distinct post-labial groove, and usually the lower lip is not connected with the upper.[1]

A pair of rostral barbels, which are usually shorter than the diameter of the eyes, are always present. For the most part they remain hidden inside a moderately deep lateral groove on either side of the snout. These lateral furrows may be indistinctly connected with the angles of the mouth.

The insertion of the dorsal fin is considerably nearer the tip of the snout than the base of the caudal fin. It is almost equidistant from the tip of the snout and the middle or the posterior edge of the base of the anal fin. It is higher than the maximum depth of the body and the length of its own base. Its last unbranched ray is weak, and the last branched ray is divided to the root. The outline is slightly concave. The pectoral fins are nearly as long as the head or a little longer. They are separated from the base of the ventrals by a distance equalling almost half their own length. When fully expanded they have a more or less rounded outer margin. The ventrals are slightly shorter than the pectorals, and are situated vertically below the 3rd or the 4th branched ray of the dorsal fin. They are separated from the commencement of the anal by a distance equalling about half their own length. The anal fin is short and is separated from the root of the caudal by a moderate distance. The caudal fin is strongly furcate, the upper lobe being usually longer than the lower. It is longer than the head and almost as long as high. The anal

[1] In a number of specimens from the streams of Manipur in Assam, 25 to 45 mm. long, I have observed that there is a well-defined post-labial groove and a distinct connection of the lower lip with the upper; and it seems highly probable that these characters become obliterated as the fish grows. Unfortunately, young specimens from Assam, as well as from other places, are not represented in a sufficient number in the collection of the Indian Museum for a detailed study.

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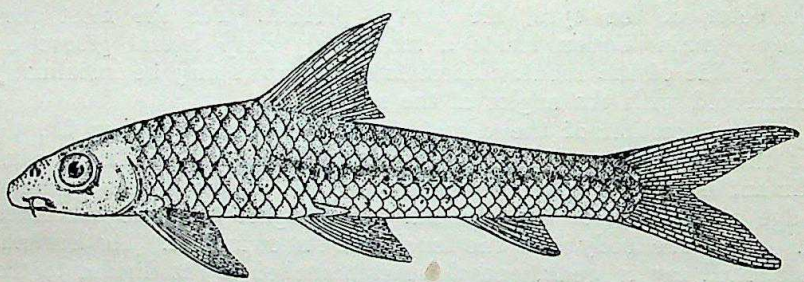
opening is variously situated. In most specimens the ventral fins extend considerably beyond it, while in others they just reach it.

The scales are of moderate size and arranged regularly. There are from 10 to 11 scales before the dorsal fin and usually from 18 to 19 round the caudal peduncle. The scales on the chest are considerably reduced in size, while those situated between the bases of the pelvic fins are somewhat enlarged. The lateral line is more or less straight and extends to the middle of the base of the caudal fin.

Colouration in alcohol is uniformly blackish above the insertion of the lateral line and whitish to faint orange below. The dorsal and the caudal fins are dusky. The other fins are almost colourless.

Assamese and Burmese form :

I have examined a large series of specimens from Assam collected by Dr. S. L. Hora from various streams in Manipur, and from Burma only three specimens, one from the Kyenchaung river in the Mergui District and two from the Phungin Hka in the Myitkyina District. So far as I can judge, the specimens from these two places do not differ in any essential characters from the typical form except in scalation and in the proportion of the



Text-fig. 6.—Lateral view of *Crossochilus latius* (Ham. Buch.) from the Mali Hka system, $\times\frac{2}{3}$.

head in the length of the body. In most specimens from Assam and in all the three Burmese individuals I have counted only 8 scales ($4\frac{1}{2}/3\frac{1}{2}$) in a transverse series and from 15 to 16 round the caudal peduncle. In some of the Assamese individuals, however, there may be one more scale in a transverse row. In the typical form there are, as already mentioned above, 10 scales in a transverse series and from 18 to 19 round the caudal peduncle. The head of both the Assamese and the Burmese form is comparatively longer than that of the typical form. Its length is contained from 4.3 to 4.8 times in the length of the body without the caudal fin (*versus* 5 to 5.2 times).

These differences, however, in the number of scales and in the proportion of the head to the length of the body, do not, in my opinion warrant a claim of a separate taxonomic position for the Assamo-Burmese group of individuals of *C. latius*, and I am inclined to consider them no more than local variations.

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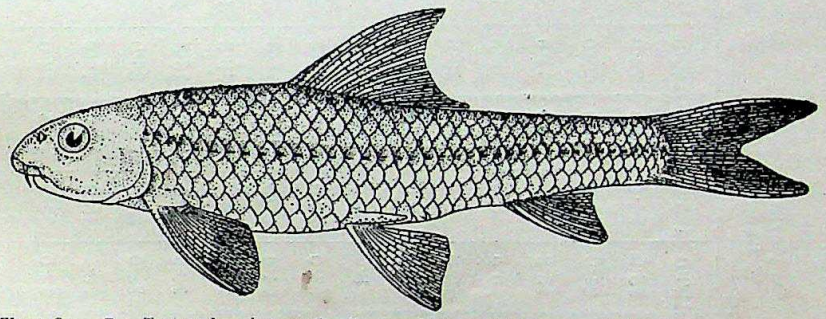
Punjab form :

I have examined[1] a large series of specimens of *C. latius* from the Punjab collected by Drs. S. L. Hora and H. S. Pruthi from Katas Nallah, Salt Range and Khewra Gorge (about 2,000 ft. elevation), and as far as I can judge from the material before me, they seem to represent a distinct form from the typical *C. latius*. In my opinion the specimens from the Punjab, at any rate, should be kept as a separate subspecies until the chief differential characters noted below can be correlated with the ecological conditions in which the fish lives. For the subspecies I propose the name **punjabensis.**

C. latius punjabensis appears to be a dwarf form, the largest specimen at my disposal from the Salt Range is 136 mm. in length. On dissecting a number of female specimens from 30 to 45 mm. in length I have found ripe eggs. Unlike the typical form, the fish is stout and thick in build. The snout is rather blunt and broadly rounded anteriorly. It is not so prominent as in the typical form, and only slightly, if at all, overhangs the mouth. Its length is contained nearly 2.5 times in the length of the head. The length



Text-fig. 7.—Lateral view of *Crossochilus latius punjabensis*, subsp. nov., slightly reduced.

of the head is contained from 4.5 to about 5 times in the length of the body without the caudal fin. The eyes are comparatively small and their diameter is contained from 4.2 to 4.7 times in the length of the head (*versus* 3.6 to 3.7 times). The fold of the upper lip is relatively shorter and less crenulated, and so is the lower lip. The body is usually considerably deeper than the height of the dorsal fin (*versus* dorsal fin higher than the maximum depth of the body). The pectoral fins are usually shorter than the length of the head (*versus* equal to or slightly longer) and consequently, the distance between the tip of the pectorals and the insertion of the ventrals is much greater than half the length of the former.

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[1] Since this report went to the press, the Zoological Survey of India received for determination a small collection of fish from Quetta from the Deputy Research Entomologist, Baluchistan. In the collection I found six specimens of different sizes, which correspond to the Punjab subspecies of *C. latius*. I am, therefore, inclined to think that the two specimens of '*Cirrhina latia* H.B.' reported by Zügmayer (*Die Fische von Balutschistan*, p. 24, Munchen, 1913) from Quetta and Kushdil Khan respectively, are also referable to *C. latius punjabensis*.

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Measurements in millimetres:

	Northern Bengal.			Manipur, Assam.			Burma.			Salt Range, Punjab.		
Length of head without caudal	120·0	105·0	92·0	105·0	83·0	50·0	150·0	119·0	109·0	90·0	80·0	68·0
Height of body	25·0	24·0	20·0	23·0	18·0	10·0	35·0	23·0	21·0	24·0	18·0	17·0
Length of head	24·0	21·0	18·0	23·0	18·0	11·5	31·0	25·0	22·5	19·0	16·0	15·0
Breadth of head	15·5	15·0	12·0	15·0	11·0	7·5	21·0	16·0	15·5	15·0	13·0	11·0
Height of head	16·5	16·0	13·0	16·5	12·0	8·0	22·0	17·0	16·5	16·0	14·0	12·0
Length of snout	10·0	9·0	8·0	10·0	7·5	4·0	14·0	11·0	9·0	7·0	7·0	5·5
Diameter of eye	6·5	6·0	5·0	5·5	4·0	3·0	8·0	7·0	6·5	4·0	3·5	3·5
Interorbital width	8·0	8·0	6·0	8·5	6·0	3·5	11·0	9·0	8·0	8·0	7·0	6·0
Height of dorsal fin	31·0	28·0	23·0	25·0	19·0	12·0	36·0	30·0	29·0	20·0	20·0	17·0
Length of pectoral fin	24·0	22·0	18·0	19·0	16·0	10·0	30·0	22·5	21·0	18·0	18·0	15·0
Length of ventral fin	22·0	19·0	17·0	18·5	15·5	8·5	29·0	22·0	19·0	16·0	15·0	13·5
Length of anal fin	20·0	18·0	17·0	15·5	12·0	8·0	27·0	19·0	...	14·0	13·0	12·0
Length of caudal fin	28·0	28·0	24·0	23·0	20·0	13·0	44·0	28·5	...	24·5	20·5	19·0
Length of caudal peduncle	20·0	18·0	14·0	15·0	14·0	7·0	22·0	19·0	17·0	12·0	11·0	9·0
Least height of caudal peduncle	12·0	11·5	9·5	12·0	9·0	5·5	15·5	12·0	11·0	10·0	8·5	8·0

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Labeo (Labeo) dyocheilus (McClell.).

(Pl. II, figs. 2 & 3; Pl. III, fig. 2).

One specimen (200 mm.) from Phungin Hka: '*Nga Lai*'.
One specimen (198 mm.) from Sinan Hka: '*Ulai*'.
One specimen (192 mm.) from Phungin Hka: '*Nga Jan*'.
One specimen (114 mm.) from Sinan Hka: '*Janri*'.
One specimen (42 mm.) from Phungin Hka: '*Ukhang*'.

In 1839, McClelland (41) described and figured the species under the name '*Cyprinus dyocheilus*' from "the clear active currents of the Bramaputra from Middle Assam to the rapids at the extremity of the valley". He further remarked that the fish "appears to be equally unknown (*sic*) in the mountain torrents and sluggish rivers and jeels of the plains". Unfortunately, both the description and the figure of the species given by McClelland are inadequate for determining the exact identity of the fish. Day, in his *Fishes of India* and *Fauna* volume gave rather a general account of the fish, but this and his figure (pl. cxxx, fig. 1) are inadequate for determining the species. According to him *L. dyocheilus* is distributed in the "Sind Hills and along the Himalayas to Sikkim and Assam" (14).

In the collection of the Indian Museum there are only three specimens labelled as *Labeo dyocheilus*, two of which were purchased from Dr. Francis Day, while the third one is a skin of a medium-sized specimen procured by Dr. S. W. Kemp from Yembung (1100 ft.) in the Abor Country in Assam (8). One of Day's specimens comes from Hardwar (No. 1522), and the other from Simla (No. 1533), and they are about 12.6 cm. and 32 cm. in length respectively. These two specimens from the Western Himalayas do not appear to me to represent the true *L. dyocheilus* so far as I am able to judge by comparison with the Abor specimen, which I consider to be the typical form of *L. dyocheilus*. It seems probable that the Western Himalayan form of the species is distinct from the one distributed along the Eastern Himalayas; but in the absence of adequate materials from both of these areas no definite decision on this point can be reached.

Recently, Messrs. G. E. Shaw and E. O. Shebbeare have collected a number of specimens from the rivers near Siliguri at the base of the Darjiling Himalayas and have presented a few of them to the Indian Museum. After a detailed study of all these specimens and comparing them with the Abor specimen, both Dr. S. L. Hora and I referred them to the typical form of *L. dyocheilus*.

In the collections of fishes from the Mali Hka system under report there are 5 well-preserved specimens, as detailed above.

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These Burmese examples, although referable to *L. dyocheilus*, differ from it to some extent in lepidosis, colouration, etc.

During the preparation of the present account, a similar specimen has been received by Dr. Hora for determination and as donation to the Indian Museum from Dr. H. M. Smith of the Department of Fisheries, Bangkok, Siam. Dr. Smith remarked that the fish "came from the north-western Siam, from a stream at Meh Sord on the Burmese border. It is unlike anything else in our collection". The specimen has, however, been identified as *L. dyocheilus*, and it may be noted that this is the first record of the species from Siamese waters. On re-examination of this Siamese specimen I find that it corresponds entirely to the Burmese form and has the same differences from the Indian individuals. Thus it seems that *L. dyocheilus* is a very variable species, and according to its geographical distribution the species may be divided into the following main groups:

(i) Western Himalayan form.
(ii) Eastern Himalayan and Assamese form, *i.e. forma typica*.
(iii) Burmese and Siamese form.

From the foregoing data it is clear that it is not possible at the present moment to deal with the Western Himalayan form, while detailed accounts of the typical and the Burmo-Siamese form may be given for future reference. Below I have given a description of the *forma typica* of *L. dyocheilus* and the diagnostic features as also figures of the Burmese type.

Forma typica:

D. 3/12; A. 3/5; P. 1/17; V. 1/7; C. 19 (excluding the small compact outer rays); L. l. 40-44; L. tr. 16-17 ($9\frac{1}{2}$-$10\frac{1}{2}$/$6\frac{1}{2}$-$7\frac{1}{2}$).

The head and the body are laterally flattened. The head is rather small and narrow, and covered with a thick integument. It is much longer than it is broad and deep, the length being contained about 4.5 times in the total length of the body without the caudal fin. It is considerably higher than broad, the breadth being almost equal to its length behind the anterior margin of the eyes. The snout is very prominent, muscular, and more or less pointed anteriorly. In some specimens, there is a distinct depression across it. A fairly deep lateral furrow is present on either side of the snout in all the specimens. The length of the snout is contained from 2.5 to about 3 times in the length of the head. It is provided all over with a series of fairly large open pores. A pendulous rostral fold is present. The eyes are rather small, have a free orbital margin, and are situated much nearer the angle of the operculum than the tip of the snout. The orbital width is contained from 4.5 to about 5 times in the length of the head,

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and almost 2 times in the length of the snout. The interorbital space is wide and slightly convex. It is nearly twice as broad as the orbital width. The nostrils are situated much nearer to the anterior margin of the orbit than to the tip of the snout.

The mouth is horse-shoe-shaped and sub-inferior. Its opening is wide, the cleft extending nearly to the level of the anterior margin of the eyes. Both the lips are continuous and more or less fleshy. There is a distinct post-labial fold, deep-set in the post-labial groove. The upper lip is protrusible and it partly overhangs the vestibulum of the mouth. The lower lip is widely separated in the middle and reflected from the lower jaw. Internally, it is covered with series of stumpy papillae. A pair of maxillary barbels, which are usually shorter than the diameter of the eyes, are situated at the angle of the post-labial fold. Both the jaws have an inner horny covering.

All the fins are well developed. The insertion of the dorsal fin is considerably nearer the tip of the snout than the base of the caudal fin. It is equidistant from the tip of the snout and the origin of the anal fin; in some cases it is much nearer the former. It is as high as or slightly less than the depth of the body below it. Its outer margin is concave. The pectorals are shorter than the head and are separated from the commencement of the ventrals by a distance equalling nearly half their own length. The ventral fins are slightly shorter than the pectorals and are separated from the insertion of the anal by a distance equalling almost half their own length. The anal fin is nearly as long as the ventrals, and when adpressed just reaches the base of the caudal fin or misses it by only a very short distance. It has a slightly concave margin. The caudal fin is much longer than the head and its own height. It is deeply furcate, the upper lobe in some grown-up specimens being slightly longer than the lower. All the rays of the dorsal, anal, pectoral and ventral fins have thin fleshy lateral lappets which are characteristic of most of the Cyprinoid fishes that inhabit the mountainous streams and rivers.

The scales are of moderate size and are arranged regularly on the body. There are from 40 to 44 scales along the lateral line and from 16 to 17 rows between the bases of the dorsal and the ventral fins. Between the base of the dorsal and the insertion of the lateral line there are from $9\frac{1}{2}$ to $10\frac{1}{2}$ rows, while between the lateral line and the base of the ventrals there are from $6\frac{1}{2}$ to $7\frac{1}{2}$ rows. The predorsal scales vary from 17 to 19. Around the caudal peduncle there are from 22 to 23 scales. The scales on the chest are considerably reduced in size. The bases of the dorsal, anal and the caudal fins are more or less scaly. The scaly appendages of the ventral fins are well-developed.

McClelland (41) has described the colouration of the fish as "bluish or brownish black above and on the extremities of the fins, but bluish-white along the belly; the sides are also bluish-white with various stains of red and yellow on the shoulder", while according to Day (14) it is "of a dull green, darkest above; fins darkest in the centre". It appears that both McClelland's and

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Day's notes on colouration of *L. dyocheilus* were made on fresh specimens. In specimens, ordinarily treated and preserved in alcohol, the colouration is from a uniform reddish to greenish-brown above and paler below. There appears to be a faint blackish patch on the 4th and 5th scale of the lateral line.

Burmese and Siamese form :

In some of the Burmese and Siamese individuals of *Labeo dyocheilus* the head may be slightly shorter than that in the typical form, and the length of the head may be contained about 5 times in the length of the body without the caudal fin. The snout is rather bluntly rounded anteriorly. The depression across the snout is very well-marked. The dorsal fin is variable in height and may be as high as, slightly more or a little less than the depth of the body below it. The pectoral fins are usually shorter than the head; but it seems that in well-grown individuals they may be a little longer. In the Siamese individual from Meh Sord, which is 222 mm. without the caudal fin, the pectorals are longer than the head.

There are from 40 to 41 scales along the lateral line and 13 rows in a transverse series. Between the base of the dorsal fin and the insertion of the lateral line there are $7\frac{1}{2}$ rows of scales, while between the lateral line and the base of the ventrals $5\frac{1}{2}$ rows. Before the dorsal there are about 18 scales, while the scales round the caudal peduncle vary from 19 to 21.

The colouration in alcohol is dark brownish above and yellowish to white below. A fairly large faint blackish precaudal blotch seems to be characteristic of the Burmese and the Siamese forms. A narrow blackish patch on the 4th and the 5th scales of the lateral line is also to be found in some individuals. All the fins are dusky. The central rays of the caudal fin are blackish. In the Siamese specimen traces of fine series of dusky longitudinal lines are discernible on each side of the body. Each scale has a faint reddish dot in the centre.

Remarks: *Labeo dyocheilus* is a very variable and widely distributed species. It is known to occur in Northern Bengal, Assam, Burma, along the Eastern Himalayas and in north-western Siam. Day's specimens from Hardwar and Simla, mentioned above, do not seem to represent this species, but any conclusive remarks on the so-called *L. dyocheilus* of the Western Himalayas, are, however, impossible till adequate material from these areas becomes available for further study.

The species is said to be common in Assam; and is known by the local name '*Gorea*'. According to McClelland its "usual size is from one to two and a half feet in length, and though sometimes coarse, its flesh is always well flavoured". Colonel Burton has noted that in the Mali river system in Upper Burma the fish grows "upto 4 lbs."

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Measurements in millimetres:

	North Bengal.	Mali Hka System.			Siam
Length of body without caudal ...	205·0	198·0	192·0	114·0	222·0
Height of body	55·0	56·0	49·0	31·0	62·0
Length of head	44·0	43·0	40·0	24·0	46·0
Breadth of head	27·5	26·0	21·0	15·0	28·0
Depth of head	34·5	34·0	29·5	19·0	39·0
Length of snout	16·0	15·0	14·0	8·5	17·0
Diameter of eye	9·0	8·5	7·5	5·5	9·0
Interorbital width	14·5	14·0	14·0	8·5	16·5
Height of dorsal fin	55·0	52·0	46·0	25·0	70·0
Length of pectoral fin ...	43·0	40·0	35·0	20·0	48·5
Length of ventral fin	41·0	37·0	32·5	19·5	45·0
Length of anal fin	41·0	36·5	35·0	19·0	47·0
Length of caudal fin	58·0	...	...	...	50·0
Length of caudal peduncle ...	38·0	38·0	35·0	23·0	45·0
Least height of caudal peduncle ...	27·0	24·5	23·5	13·5	28·5

Barbus compressus Day.

(Pl. I, Fig. 6).

One specimen (122 mm.) from Tang Hka: '*Urat*'.

In 1869, Day (10) described the species from a single specimen, the precise locality of which was not known. He remarked: "The native country of the type-specimen is uncertain, but the fish was found in a bottle in the Calcutta Museum with an *Oreinus* from Cashmere. It is a fine specimen in excellent preservation". Unfortunately, since Day's discovery of the species further material was not available to clear up the doubt in regard to the *provenance* of this interesting fish and consequently little or no attention has been paid to the species. In the collection of the Indian Museum the unique type-specimen of *B. compressus* is preserved in the original bottle. The specimen has not undergone any marked

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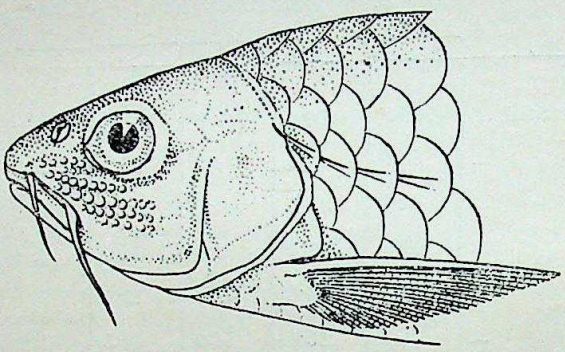
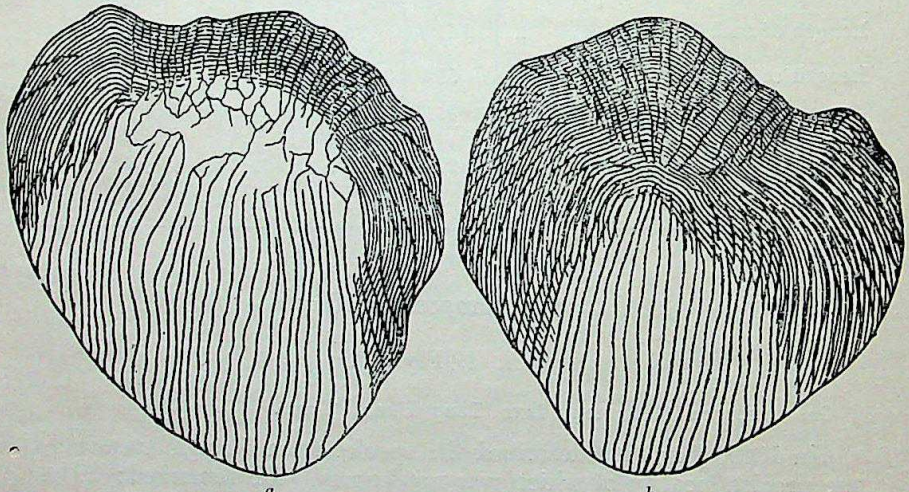
deterioration through preservation in alcohol for a period of sixty-four years, except for the colouration which is completely lost.

In the collection of fishes from the Mali Hka system there is a fine specimen which agrees in all essential characters with the type-specimen of *B. compressus* of Day, and I have not the least hesitation in assigning the fish to this species. In view of the fact that *B. compressus* stands rather on an inadequate description based on a single specimen and that the fish has not been figured so far, I take this opportunity to give a detailed description of the species based on a comparative study of both the type-specimen and the Mali river example and to publish an illustration of the latter. To facilitate comparison, a



Text-fig. 8.—Lateral view of the anterior portion of the head and body of the type-specimen of *Barbus compressus* Day showing the characters of the eyes, mouth, the lips and the barbels etc., ×1½.



a *b*

Text-fig. 9.—*a*. Scale from the base of the dorsal fin of the type-specimen of *Barbus compressus* Day, ×6.
b. Scale from the base of the dorsal fin of *Barbus compressus* Day from the Mali Hka system, ×6.

figure of the anterior portion of the type-specimen, showing the characters of the head and eyes, etc. is also added (Text-fig. 8). Characters of scales have often been considered to be of specific value among Cyprinoid fishes. I have, therefore, given camera lucida drawings of the scales of the two specimens under report,

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The scales are taken from below the base of the dorsal fins (Text-fig. 9, *a* & *b*). It is clear from the structure of these scales that they are more or less similar except for some minor differences which are almost certainly due to a difference in the age of the two specimens.

D. 4/8; A. 3/5; P. 1/14; V. 2/8; C. 26 (excluding the small compact outer rays); L. l. 25-26; L. tr. 7 ($4\frac{1}{2}/2\frac{1}{2}$).

The dorsal outline ascends gradually from the tip of the snout to the nape where it falls slightly and then rises up again to the origin of the dorsal fin. Beyond this point the outline slopes down rather abruptly and converges to the base of the caudal fin. The ventral outline is feebly convex throughout.

The head is conical, considerably compressed; and its length is contained nearly 4 times in the length of the body excluding the caudal fin. It is higher than wide, the maximum height being equal to the length of the head without the snout, while the width is equal to the length of the head behind the middle of the eyes. The snout is obtusely pointed and almost as long as the diameter of the eyes. The eyes are of moderate size and situated in advance of the middle of the head. Their diameter is contained nearly 4 times in the length of the head. The interorbital region is somewhat convex and its width is nearly equal to or slightly less than the diameter of the eyes. There are 5 to 6 transverse series of well developed conical tubercles on the anterior portion of the cheeks. On the snout there are no pores. The lips are thick and fleshy. The upper jaw is slightly longer than the lower one and is protrusible. Two pairs of barbels are present. The maxillary barbels are slightly longer than the diameter of the eyes. The rostrals are shorter than the maxillaries.

The dorsal fin is situated much nearer to the tip of the snout than to the base of the caudal fin. The insertion is vertically above the posterior margin of the 7th scale of the lateral line. The last undivided dorsal ray is fairly strong and smooth posteriorly. The height of the dorsal fin is as long as the head behind the opening of the nostrils. Its outer margin is slightly concave. The pectorals are as long as the head excluding the snout, and are separated from the insertion of the ventrals by a distance equalling about $\frac{1}{3}$ their own length. The ventrals are considerably shorter than the pectorals and are separated from the origin of the anal by $\frac{1}{2}$ their own length. The anal fin is rather short and extends to the middle of the caudal peduncle. Its outer margin is similar to that of the dorsal. The caudal fin is longer than high, the length being slightly more than the length of the head without the snout.

The scales are large and arranged regularly. There are 9 scales before the dorsal fin and 10-11 round the caudal peduncle. The bases of the dorsal and the caudal fins are scaly. The scaly appendages of the ventrals are fairly well developed.

The colouration of the type specimen has been described by Day as "silvery, fins stained darker". But, as already mentioned, the original colour of the specimen is totally lost. It is now

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uniformly brownish with a faint golden sheen. The specimen from the Tang Hka is dusky all over the body above the lateral line and pale yellowish below. A fairly large black ocellus is present at the base of the caudal fin. Each scale is marked with a small dusky spot at the base. All the fins are dusky.

According to Colonel Burton's notes the fish is said to grow "up to 4 lbs.".

Remarks: From a careful examination and a thorough comparison of the two specimens under report I am convinced that the Burmese example is indistinguishable from the type-specimen of *B. compressus* Day. It is impossible, however, to come to any definite conclusion in regard to the type-locality and the distribution of the species even in the light of the present discovery of the species from Burma. For, on the one hand, its distribution may be sporadic in Kashmir and in Burma, while on the other, the fish may be an endemic Burmese form. Considering the very specialised nature of the fish-fauna of Kashmir, the former does not seem to me to be very probable, while in the event of the latter being true, which I am more inclined to believe, it is self-evident that, through inadvertence, the type specimen of *B. compressus* had been put in the same bottle with an *Oreinus* from Kashmir.

Measurements in millimetres:

	Type specimen	Burmese specimen
Length of body without caudal	155·0	122·0
Height of body	40·0	34·0
Length of head	38·0	31·0
Breadth of head	23·0	18·0
Height of head	27·5	22·0
Length of snout	11·5	10·0
Diameter of eye	10·0	8·5
Interorbital width	9·5	7·5
Height of dorsal fin	34·0	26·0
Height of last undivided dorsal ray	34·0	26·0
Length of anal fin	27·5	20·0
Length of pectoral fin	32·0	24·5
Length of ventral fin	26·0	18·5
Length of caudal fin	(Broken)	24·0
Length of caudal peduncle	30·0	20·0
Least height of caudal peduncle	18·5	13·5

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Barbus tor (Ham. Buch.) *sensu lato.*

One specimen (190 mm.) from Phungin Hka: *'Shabyin Ningshaw'*.
One specimen (134 mm.) from Phungin Hka: *'Nga Rat'*.
One specimen (132 mm.) from Tang Hka: *'Shamyin Ningshaw'*.
One specimen (64 mm.) from Phungin Hka: *Hkauka La'*.

In a recent paper Deraniyagala (17) has revived the genus *Tor* Gray (1833) of which *'Cyprinus tor'* of Hamilton Buchanan is the type. In the *Genera of Fishes*, Jordan (39) remarked that *Tor* Gray "replaces *Labeobarbus* Bleeker" (p. 139), while about *Labeobarbus* Rüppell (1836) he opined that the genus is "probably not distinct from *Tor* Gray" (p. 186). In the absence of any definite data in regard to the specific limit of Buchanan's (20) *C. tor* which he obtained from the Mahananda River in Northern Bengal, I am unable to agree with Deraniyagala's contention about using the name *Tor* for the species in preference to *Barbus* of Cuvier (1817) of which, *Labeobarbus* and certain other so-called allied genera have by most authors been considered synonyms. In this connection Günther's (19) useful remarks may be quoted. He observed: "Many attempts have been made to divide the Barbels into generic groups, as may be seen from the synonymy. And, indeed, when we consider the great number of species, and the great apparent diversity between the first and the last of the series, a further division must appear to be highly desirable. Yet nothing would be more contrary to the idea of natural genera, the transition from one extreme species to the other being perfect; and those attempts at generic subdivisions prove that the naturalists who proposed them had only a partial acquaintance with the species. The size of the scales, the development of the third dorsal ray, the form of the snout (and consequently of the preorbital) are perfectly useless as generic characters, in consequence of the complete series of intermediate forms. The lips are subject to variation in the same species: thus, for instance, some specimens of *B. bynni* would belong to *Barbus*, others to *Labeobarbus*" (p. 84).

This remark applies equally truly in the case of the genus *Tor* and the species *B. tor*. It is a well-known fact that great confusion centres round the true systematic position of *B. tor*, which is due entirely to the extreme variability of certain differential characters that are ascribed to the species, *viz.*, the length of the head and its proportion to the length of the body, the shape and size of the snout, the nature of the lips, the mesial lobe and the lepidosis, etc. All these features have frequently been found to vary so much in *B. tor* that they almost entirely overlap the distinguishing characters of the so-called allied genera and of the related species. Under these circumstances, I am of opinion that it is futile to recognise the genus *Tor* for such fishes as are widely variable in those very characters on which the genus is based, and that *B. tor* should be regarded as a composite and variable species of *Barbus* until it is possible to understand and define properly the specific limits of Hamilton Buchanan's *'Cyprinus tor'*.

The specimens under report from the Mali Hka system have

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the dorsal fin rays stained with black. Series of black marks are present in the centre and on the posterior edge of the scales. The pigmentation is more prominent in the upper half of the body than in the lower.

It has been noted in the field-notes of Colonel Burton that the species grows "up to 60 lbs." The fish, however, has been known in Burma to grow to a much larger size, weighing over 90 lbs.[1]

Barbus clavatus burtoni, subsp. nov.

(Pl. III, Fig. 1).

Three specimens (162, 130 and 110 mm.) from Phungin Hka: *'Nga Ju'*.
One specimen (83 mm.) from Tang Hka: *'Nga Ju Chang'*.
One specimen (80 mm.) from Sinan Hka: *'Nga Ju'*.
One specimen (74 mm.) from Tang Hka: *'Nga Ju Hpraw'*.

In 1921, Hora (23) discussed at some length the affinities of *Barbus clavatus* McClelland with its allies and published a description and a figure of the species from several fresh specimens collected by him from the Senapati stream near Kairong in the Naga Hills in Assam. *B. clavatus* has hitherto been found in rivers at the foot of the Sikkim mountains on the northern frontier of Bengal and in the Naga Hills in Assam. Among the fishes of the Mali river system of the Myitkyina District under report, there are 6 well-preserved specimens, as detailed above, which, though very closely related to *B. clavatus*, differ from it in certain characters by which they may be allotted to a separate group. Besides these specimens from the tributaries of the Mali Hka, I have also examined a similar, but much larger specimen (172 mm.) collected by Mr. A. Macdonald from Sahmaw in the Myitkyina District and sent by the Curator of the Bombay Natural History Society to Dr. S. L. Hora for study, in March, 1926. On referring the matter to Dr. Hora and looking through the correspondence, I gather that, from an examination of the specimen in question, Dr. Hora came to a provisional conclusion that it represented a new form from Burma. He also had drawings made of this unique specimen with a view to publish an illustrated account of the fish in the Bombay Natural History Society's Journal as soon as a few more specimens of this interesting fish were available from the same locality for testing the adequacy of the description. But no more examples were obtained and the Sahmaw-fish, therefore, remained undescribed. Having before me a fine series of the same fish in Colonel Burton's collections from the same district of the northern frontier of Burma, it is now possible to judge of the affinities of the fish and to publish its description with figures. I am in agreement with Dr. Hora's original views about the form being new to science and I refer the specimen from Sahmaw, as well as the ones from the Mali Hka system, to a new subspecies of *B. clavatus*. I have the greatest pleasure in associ-

[1] Hertz, W. A., *Burma Gazetteer, Myitkyina District*, p. 17 (Rangoon, 1912).

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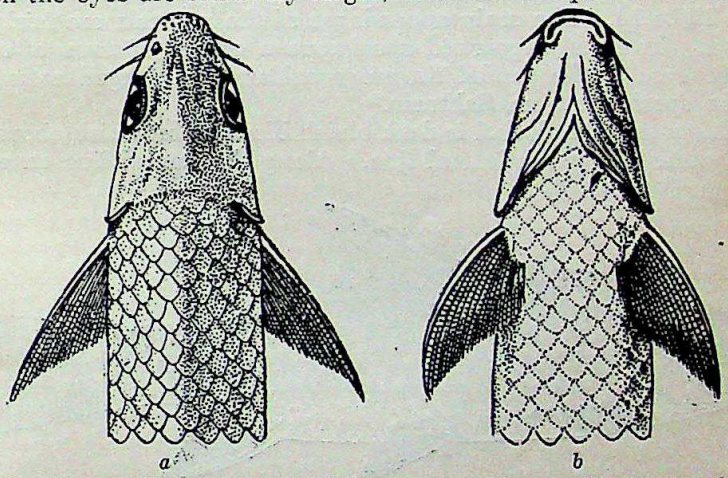
ating the new form with the name of Lt.-Col. R. W. Burton. The fish may be characterised as follows:

D. 4/8; A. 3/6; P. 1/16; V. 1/8; C. 19 (excluding the small compact outer rays); L.l. 35-38; L. tr. 10. ($6\frac{1}{2}/3\frac{1}{2}$).

Barbus clavatus burtoni differs from the typical form chiefly in size, lepidosis, certain body proportions, colouration, etc. It seems to represent a much larger form than *B. clavatus*, as I find from an examination of the specimens of the latter form from the Senapati stream referred to above as well as two others collected by Dr. Murray Stuart from the Loglai and the Taron rivers in the Naga Hills. All these specimens from Assam are from 45 to 120 mm. in total length without the caudal fin, and some of them about 70 mm. in the minimum and 120 mm. in the maximum are gravid females, whereas the largest female specimen of *B. clavatus burtoni* from the Myitkyina District is 172 mm. long.

The head is short and conical and its length is contained from almost 4 to 5 times in the total length of the body without the caudal fin. It is proportionately longer in young specimens than in adults. The snout is obtusely pointed and is longer than the diameter of the eyes in adult individuals, while in young forms, in which the eyes are relatively larger, it is almost equal to the orbital



Text-fig. 10.—*a*. Dorsal view of the anterior portion of the head and body of *Barbus clavatus burtoni*, subsp. nov., ×*ca*. $\frac{2}{3}$.
b. Ventral view of the same, × *ca*. $\frac{2}{3}$.

width. Its length is contained from 3 to 3.3 times in the length of the head. It is provided with 2 or 3 rows of horny tubercles, which are less pronounced in immature stages. The eyes are fairly large and are situated nearer the tip of the snout than the free margin of the operculum. Their diameter is contained from 3.3 to about 4 times in the length of the head. The interorbital space is convex and greater than, or almost equal to the orbital width according as the fish is grown up or young.

The mouth is horse-shoe-shaped and sub-inferior. The cleft of the mouth extends nearly to the level of the anterior margin

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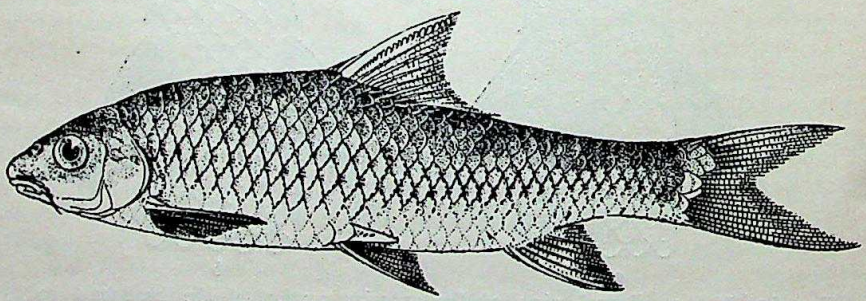
of the orbit. Both the lips are fleshy and continuous, the upper one partly overhanging the lower, which is widely interrupted in the middle. A fleshy pendulous rostral fold is present. There are two pairs of barbels, which are of nearly equal length. They are as long as the diameter of the eyes or slightly longer.

The dorsal fin is inserted almost in the middle of the distance between the tip of the snout and the base of the caudal fin, or slightly nearer the former than the latter. It is of considerable height, but its last osseous spine which is sharply denticulated posteriorly, is not so high as the depth of the body below it. Its outer margin is deeply concave. The pectorals are shorter than the head, but longer than the ventrals. The anal fin is rather short and has more or less a straight outer margin. The caudal fin is deeply forked and usually longer than the head and its own height. In some grown-up specimens the upper lobe is a little longer than the lower. The caudal peduncle is considerably longer than high, specially in adult individuals.

The scales are fairly large and arranged regularly. There are from 35 to 38 scales along the lateral line, and 10 rows between the bases of the dorsal and the ventral fins. Between the base of the dorsal and the lateral line there are $6\frac{1}{2}$ scales, while $3\frac{1}{2}$ between the lateral line and the ventrals. The predorsal scales vary from 12 to 14. The scaly appendages of the ventrals are fairly enlarged. In some large-sized specimens a couple of rows of scales at the base of the caudal fin are considerably enlarged as is seen in the specimen from Sahmaw.[1]

Colouration in alcohol is dark bluish-black or brownish above and pale white below the lateral line. Along the lateral line on either



Text-fig. 11.—Lateral view of a specimen of *Barbus clavatus burtoni*, subsp. nov. from Sahmaw in Upper Burma showing colour variation, × *ca.* $\frac{1}{2}$.

side is present a more or less complete and distinct band in some specimens, while in others, as in the Sahmaw specimen, the free margins of a few longitudinal rows of scales are dotted with fine blackish pigment forming a meshy design (Text-fig. 11). The fins are dusky to whitish. The outer borders of the caudal fin are tipped with black.

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[1] I am indebted to Dr. S. L. Hora for kindly allowing me to publish his manuscript drawing of the Sahmaw-specimen.

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Remarks: *B. clavatus burtoni* may be easily distinguished from the typical form by its longer snout, shorter third spine of the dorsal fin, fewer scales along the lateral line, in a transverse series and before the dorsal fin, and by the colouration which is more dark than bright and silvery. According to Colonel Burton's field-notes, the fish grows "up to 7 lbs."

Distribution: Tributaries of the Mali Hka and Sahmaw in the Myitkyina District of Northern Burma.

Type-specimen: No. F. $\frac{11437}{1}$ preserved in the collections of the Zoological Survey of India, Indian Museum, Calcutta.

Measurements in millimetres:

	Sahmaw	Mali Hka system		
Length of body without caudal ...	172·0	162·0	110·0	83·0
Height of body	42·0	41·0	30·0	25·0
Length of head	35·0	35·0	26·0	20·0
Breadth of head	23·0	21·0	14·0	11·5
Depth of head	28·0	27·0	19·0	15·0
Length of snout	11·5	11·0	8·0	6·0
Diameter of eye	8·5	9·0	7·5	6·0
Interorbital width	10·5	10·5	8·0	5·0
Height of dorsal fin	32·0	36·0	25·0	18·0
Length of pectoral fin	30·0	32·0	21·0	15·0
Length of ventral fin	26·0	29·0	19·0	13·0
Length of anal fin	28·0	25·0	18·0	11·5
Length of caudal fin	44·0	38·0	30·0	23·0
Length of caudal peduncle	29·0	30·0	22·0	15·0
Least height of caudal peduncle ...	16·0	18·0	12·0	10·0

Barbus chagunio (Ham. Buch.).

One specimen (125 mm.) from Phungin Hka: *'Chyet neug'*.

The occurrence of this species in the Burmese waters was unknown till its recent report from the Myitkyina District in Upper Burma by Prashad and Mukerji (45). The specimen under report agrees perfectly with the description of the Burmese specimens given by these authors.

There had been a certain amount of confusion in regard to the specific validity of *B. chagunio*, and the matter was discussed in detail by Hora (32). The relationship of the species *B. chagunio*

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with *B. spilopholus* of McClelland had also been a matter of dispute. Quite recently it has been shown by Hora and Mukerji (38) that *B. spilopholus* is conspecific with *B. chagunio*. The species is sexually dimorphic. *B. spilopholus* with the prolonged anal rays and well developed tuberculated pads on the snout and the cheeks represents a male, while *B. chagunio* without such characters is a female.

The specimen from the Phungin Hka is a female. It has no definite pores or tubercles on the snout and the cheeks, nor the elongated anal rays.

According to Colonel Burton's notes the fish is said to grow "up to 2 lbs."

Barbus chola (Ham. Buch.).

One specimen (90 mm.) from Phungin Hka: '*Shalum shawng*'.

A very faint blackish mark is present in the middle of the caudal peduncle. Another deep black blotch behind the gill opening is characteristic of the Burmese specimens. The dorsal fin has a black mark along the anterior part of its base and another along the centre. Posteriorly the scales have a dusky spot.

Barbus sarana caudimarginatus Blyth.

One specimen (154 mm.) from Phungin Hka: '*Nga pawk*'.
One specimen (150 mm.) from Phungin Hka: '*Nga bupawk*'.
One specimen (180 mm.) from Phungin Hka: '*Nga tawt*'.

The three specimens, although they have different local names, are all referable to this species. According to Colonel Burton's field-notes '*Nga bupawk*' grows "up to ½ lb.", while '*Nga pawk*' and '*Nga tawt*' grow in weight "up to 2 lbs.", and "4 lbs.", respectively. Since all the specimens represent a single species, these weights must refer to different sizes and, presumably, ages of the fish.

The barbels are blackish dorsally and whitish below. Both the dorsal and the caudal fins are tipped with black. There are very fine blackish longitudinal lines along the sides.

Semiplotus semiplotus (McClell.).

One specimen (44 mm.) from Phungin Hka: '*Salep la*'.
One specimen (67 mm.) from Sinan Hka: '*Salep la*'.
One specimen (90 mm.) rom Phungin Hka: '*Shalum shawng*'.
One specimen (115 mm.) from Tang Hka: '*Udi*'.
One specimen (150 mm.) from Phungin Hka: '*Wudi*'.

According to Colonel Burton's field-notes, in young stages the species is locally believed to represent a "small variety" and known as '*Salep la*'; but when the fish grows to a weight from "4 lbs. to 7 lbs." it is known by the name '*Udi*' or '*Wudi*'.

In all the specimens under report there are from 9 to 12 pores on either side of the snout. The last undivided dorsal ray is slightly longer or shorter than the length of the head according as the specimen is grown-up or young. The same is true in regard to the length of the pectoral fins.

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GENUS : **Rohtee** Sykes.

Most of the earlier ichthyologists adopted the name *Osteobrama* Heckel in preference to *Rohtee* Sykes. Hora (23) has already discussed the matter and has pointed out that Sykes' work (51) was published in 1841, while Heckel established his genus *Osteobrama* in 1843, and that according to the International Rules of Zoological Nomenclature Sykes' genus *Rohtee* has priority over *Osteobrama* of Heckel.

Recently, Tchang (52) has established a genus allied to *Rohtee* (=*Osteobrama*) which he calls *Parosteobrama* to accommodate two specimens of his *P. pelligrini* collected from 'Se-tchuan' (Sze-chuan) in China. He has defined the genus as follows:

"Corps comprimé; bouche termnale et verticale lèvres cornées; linge latérale plus rapprochée du ventre que du dos; dents pharyngiennes sur 3 rangées; vessie natatoire en 3 parties; dorsale débutant plus près de la caudale que du bout du museau, son troisième rayon simple ossifié, mais sans denticulations; anal longue; abdomen tranchant.

Ce genre est voisin de *Osteobrama* Heckel (*Rohtee* Sykes); il s'en distingue par ses lèvres cornées et par la vessie natatoire en 3 parties."

From the generic definition of *Parosteobrama* as well as from the illustrated description of the species, *P. pelligrini* I find that Tchang has considered the horny jaws and the tri-chambered air-bladder to be the chief distinguishing features.

In certain species of the genus *Rohtee* there is an indication of horny pads on the jaws, and in *Parosteobrama* this condition is probably accentuated.[1]

In my opinion, therefore, the horny covering on the jaws in fishes should, in most cases, be correlated with the environmental conditions of the fish and considered as an adaptive modification, which must vary in accordance with the necessity and the degree of adaptability.

In regard to the three-chambered air-bladder, Tchang observes "vessie natatoire en 3 parties, la premiere, ovale et arrondié aux deux bouts, la deuxieme plus longue que la premiere, la troisieme tres petite". Unfortunately, the author has not published any

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[1] Since this report went to the press, Messrs. H. W. Wu and K. F. Wang's interesting paper—'Preliminary note on the lips of *Parabramis terminalis* (Richardson)'—published in *Contrib. Biol. Lab. Sci. Soc., China*, viii, *Zool. Ser.*, No. 10 (1932) has become available. In dealing with the structure of the epidermis of the lips of *Parabramis terminalis*, which are 'more or less horny in appearance' in specimens preserved in formalin or alcohol, the authors point out 'Tchang recognizes the particular structure as a horny lip (levres cornées) as a characteristic to his new genus in describing *Parosteobrama pelligrini* which is exactly synonymous of the present species. The so-called horny lip which is considered as a characteristic of the genus *Parosteobrama* is merely the highly developed epidermis of the skin covering the surface of upper and lower jaws, and the outer layers of epithelial cells have to become flattened and more or less cornified.'

This corroborates my view regarding the stability of the structure of the lips in *Parosteobrama* and the inference in respect of the validity of the genus.

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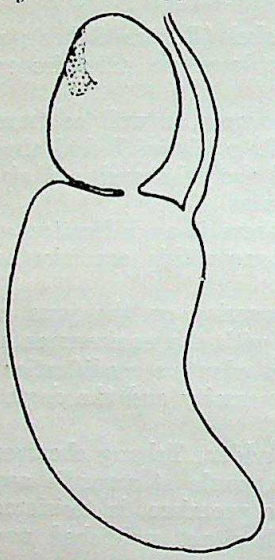
illustration of this organ, which in view of its having an additional small third chamber is very interesting. As is well known, in most of the Cyprinoid fishes the air-bladder is bi-chambered. If, therefore, the tri-lobed air-bladder of *P. pelligrini* is proved by the future researches to be a constant feature, the fish will have a claim to a genus to itself. At this stage, however, this character cannot be stressed, inasmuch as the conclusion arrived at by Tchang is based on insufficient data. Moreover, the structure of the air-bladder, although considered to be of taxonomic value, has been known to vary considerably in many Cyprinoid fishes. Hora (24), who studied at some length the structures of the swim-bladder in certain Indian fishes, and specially of the various species of the genus *Garra*, found so much structural variation of this organ that he "was almost tempted to regard it as a specific character; but further examination showed that it is not only variable in the different species of the genus (*Garra*) but differs in individuals of the same species as well". I have examined the air-bladder of *Rohtee vigorsii*, the type-species of the genus, and also of *R. duvaucelii* and *R. feae* from Burma. In all these species I have found that there are only two chambers. The anterior chamber is medium-sized and more or less oval in outline, while the posterior one is fairly large and bean-shaped. The chambers are connected together by a narrow duct at a constriction whence the pneumatic duct arises (Text-fig. 12). The aforesaid three species, as also the rest of the species of the genus *Rohtee*, are not so well represented in the collection of the Indian Museum as to allow many specimens to be dissected, and it is, therefore not possible for me to judge the nature and range of variation of this structure in *Rohtee*, and to throw light on that of *Parosteobrama*.



Text-fig. 12.—Air-bladder of *Rohtee duvaucelii* (Cuv. & Val.) from the Myitkyina District, Upper Burma, ×2.

Another feature which Tchang has included in the generic definition of *Parosteobrama* is that the last osseous ray of the dorsal fin is not serrated, while in *Rohtee* it is usually serrated. In this connection reference may be made to a species of *Rohtee*, *R. cumna* (Tickell) Day in which the last osseous ray is simple. The fish was procured and reported by Colonel Tickell from Mandalay in Burma and considered as a valid species by Day. In his *Supplement to the Fishes of India* Day (15) has also re-defined the fish. Vinciguerra (53), however, accepts the validity of this feature in *R. cumna* with reserve and doubts the accuracy of the structure concerned in Tickell's original drawing of the species.

It is thus clear that to be certain about the validity of the genus *Parosteobrama* examination of further material is essential.

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If such an examination reveals that the horny covering on the jaws, the tripartite condition of the air-bladder and the smooth nature of the last osseous ray of the dorsal fin are constant characters in a large series of specimens, *Parosteobrama* will then stand on a firmer basis.

Rohtee duvaucelii (Cuv. & Val.).

One specimen (105 mm.) from Phungin Hka: '*Shaping-naw-naw. kpa*'.

A curious confusion has found currency in the ichthyological literature, both earlier and modern, about the use of the specific name of this species. In 1844, Cuvier and Valenciennes described the species for the first time on page 77 of the 17th volume of their *Histoire Naturelle des Poissons* under the denomination "La Breme de Duvaucel: *Leuciscus Duvaucelii*" after the name of M. Alfred Duvaucel who collected the type specimen from "Nepaul". In the index of the same volume which is prefixed to the text, the name "La Breme d'Alfred (*Leuc. Alfredianus* nob)" is printed on page xvi. But the references affixed to this name are made to the description of *L. Duvaucelii* (p. 77) and to a coloured plate of the fish, No. 488 bearing the legend "*Leuciscus Alfredianus* nob". This discrepancy has resulted in the indiscriminate use of both the names, *duvaucelii* and *alfredianus* in the literature. Under the circumstances it is necessary to decide the question of the nomenclatural status of the two names used by Cuvier and Valenciennes for the same fish. So far as I am able to judge, the question of the "Law of Priority" of names or of "page precedence", as embodied in the International Code of the Zoological Nomenclature does not seem to arise here, nor is there any existing code of nomenclature which provides for such a case as that under consideration. In view of this fact the name *duvaucelii* under which the species was described should, in my opinion, have a natural right to exist, while *alfredianus*, a misnomer in all probabilty, should be eliminated from nomenclature.

In 1924 Myers (43) described a new species of *Rohtee*, *R. roeboides* from a single young specimen, 80 mm. excluding the caudal fin. The fish was collected from Monywa on the Chindwin river in Upper Burma. In a letter Dr. G. S. Myers wrote to me: "In working with the Burmese fishes you may have occasion to examine the cyprinoids I described in 1924. I have become dubious of the validity of *Rohtee roeboides* and *Barbus nicholsi*[1] and should welcome any attempt to properly place these fishes." But since in the absence of typical specimens it is not possible to arrive at

[1] I take this opportunity to point out in passing that Dr. D. Vinciguerra described an African species of *Barbus* under the name '*B. Nicholsi*' (*Ann. Mus. Civ. Stor. Nat. Genova*, LIII, p. 11, 1928). According to the International Rules of Zoological Nomenclature, Art. 35, *B. nicholsi* Vinciguerra (1928) becomes a homonym of *B. nicholsi* Myers (1924). I directed the attention of Dr. Vinciguerra to this point who agreed with me and kindly allowed me the liberty to propose a new name for his species. I have great pleasure in renaming the fish as **B. vinciguerrae**.

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any definite conclusion in regard to the validity of these fishes and specially of *R. roeboides*, which concerns me in connection with my present studies, a request was made to Dr. J. T. Nichols of the American Museum of Natural History to send to the Indian Museum the types of these fishes for my examination. In reply Dr. Nichols kindly informed: "I regret that we cannot send you the types of Myers' species for examination, as we are not permitted to send such material outside the country". Thus I have had no chance of examining the type of *R. roeboides*. From Myers' description of the species, however, and after examining a large series of specimens of *R. duvaucelii* of different sizes as well as of the other species of the genus hitherto known from Burma, I have come to a provisional conclusion that *R. roeboides* is strikingly similar, if not identical with *R. duvaucelii*. Myers has already remarked that the species is "related to *Rohtee cotio* (Hamilton Buchanan) and *R. duvaucelii* (Cuvier and Valenciennes)" but "differs from *cotio* and *duvaucelii* in fewer scales (49) and shorter pectorals". It seems that Myers had no specimens of these two species before him for comparison with his species, and that he, therefore, depended considerably on Day's descriptions and figures of these fishes. He pointed out (p. 3 footnote): "Day's figure of *duvaucelii* (*alfrediana*) shows only 45 scales". Unfortunately, Day's descriptions and figures that are given in his *Fishes of India*, though standard references on the subject even today, have often been found to be inadequate and inaccurate for the purpose of understanding the precise limits of the various species; and any conclusion based merely on Day's observations and figures is likely to lead to a mistake.

In an earlier account of the fishes of the Myitkyina District in Upper Burma it has been already pointed out by Prashad and Mukerji (45) that in *R. duvaucelii* the lepidosis is very variable. The number of scales along the lateral line varies from 48 to 52 and there are $9\frac{1}{2}$ to $10\frac{1}{2}$ rows in a transverse series. This conclusion was arrived at after examination of a large series of specimens of the species from various localities. The presence of 49 scales along the lateral line in *R. roeboides*, therefore, does not, *per se*, preclude its assignment to *R. duvaucelii*. In all other respects, as far as I can judge, *R. roeboides* is indistinguishable from *R. duvaucelii*, except for the shorter pectorals. In all the specimens of *R. duvaucelii* that I have examined the pectoral fins either just reach the pelvics or extend slightly beyond them. The length of these fins and their relative proportions, specially in immature stages, can, however, be barely considered to be of specific value.

Barilius barna (Ham. Buch.).

One specimen (53 mm.) from Phungin Hka: '*Shapyin*'.
One specimen (65 mm.) from Tang Hka: '*Nyimaungiza*'.
One specimen (76 mm.) from Phungin Hka: '*Shapyin Pyinnen*'.
One specimen (80 mm.) from Tang Hka: '*Shapin*'.
One specimen (100 mm.) from Phungin Hka: '*Nga-chyet-new*'.

Although the specimens from different localities as well as from the same locality are known by different local names as quoted

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above, all undoubtedly belong to *B. barna*. The species is very variable in respect of the presence or absence of barbels, their numbers and the colour pattern, etc. Hamilton Buchanan (20), Günther (19) and Day (14, 16) observe that barbels are entirely absent in *B. barna*. I have examined a large series of specimens of the species from different places in India and Burma and have found that in some only minute maxillary barbels are present, while others are provided with both the maxillary and the rostral pairs. Specially among the specimens of the species from the Siju Cave and the Garo Hills in Assam, I have found many that are provided with one or both the pairs of barbels. Specimens from Burma under report are, however, devoid of barbels excepting the one from the Tang Hka (80 mm.) which has a rudimentary pair of maxillary barbels.

The species seems to be sexually dimorphic so far as it could be ascertained from the nature of the tuberculated structures on the snout, cheeks and on other parts of the body. In males the snout, the jaws, and the lower portion of the cheeks are thickly covered with pointed horny tubercles. In grown-up males 3 or 4 outer branched rays of the pectoral fins have soft cushion-like elevated ridges in the middle, situated dorsally. These pad-like structures are covered with minute tubercles. Some fine tubercles are also present on the last few branched rays of the dorsal fin of some of the males. In all the specimens the lower lobe of the caudal fin is longer than the upper. In Burmese forms this feature appears to be more pronounced than in the Indian individuals.

Broad, black vertical bands at the sides, which vary from 7 to 9, are present in all the specimens. The dorsal fin is edged with black and white, white on the top and black below. In most individuals the scales of the upper portion of the body have a fine blackish outline.

Barilius barila (Ham. Buch.).

One specimen (81 mm.) from Phungin Hka: '*Hkumpyi Ulum*'.
One specimen (81 mm.) from Phungin Hka: '*Shapyin*'.
Two specimens (95 and 105 mm.) from Tang Hka: '*Shapin*'.
One specimen (101 mm.) from Siman Hka: '*Shapyin-Pyinzut*'.

It appears from the local names quoted from the field-notes of Colonel Burton that the fish is known by different names in the same and in different localities. Comparing certain local names of *B. barila* with those of *B. barna* it further appears that in certain localities, at any rate, the Kachins do not recognise them as two distinct species. For instance, both the species are known by the names '*Shapyin*' and '*Shapin*' at Phungin Hka and Tang Hka respectively, although elsewhere they have other local names.

Like the preceding species, *B. barila* is considerably variable in respect of certain characters, and at certain stages of growth the two species are so very similar that it is difficult to differentiate one from the other. In this connection mention may be made of *B. barnoides* described from 'Catchin' in Burma by Vinciguerra (53). I have examined a para-type of the species kindly presented to the Indian Museum by Dr. D. Vinciguerra. A thorough

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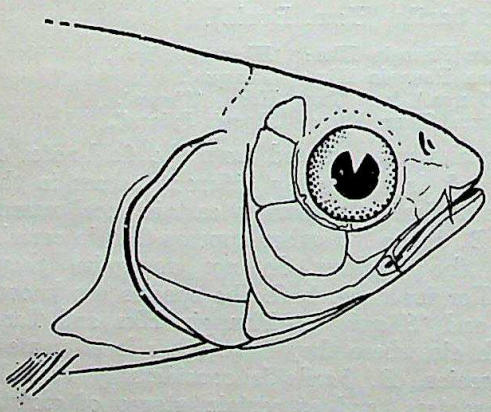
examination of this form and a detailed comparison with its allies has convinced me that *B. barnoides* is conspecific with *B. barila*. I have discussed this matter below under a separate heading.

Both Hamilton Buchanan (20) and Günther (19) have observed that in *B. barila* the barbels are absent, while according to Day (14, 16) "a small rostral pair is present". Of the earlier authors, Day has given undue importance to the nature and the number of the barbels in regard to the systematic classification of the different species of the barbelled Cyprinid genera. He has based his synopsis of the species of the genus *Barilius* on the presence or absence of barbels. But this has been found to be faulty which is due partly to Day's having overlooked the minute tendrils in many species of *Barilius*, and partly to his having been influenced by the *a priori* observations of other authors. Day's synopsis of the species of the genus *Barilius* can, therefore, be hardly rigidly adhered to in the matter of determining the specific identity. I have examined large series of *B. barila* from different localities and have found that in most cases there are two pairs of barbels, while two barbels and no barbels are found only in a few cases. In all the specimens from the Mali Hka system there are two pairs of barbels. The rostrals are nearly twice as long as the maxillary barbels.

The sides and the lower portion of the mandible as also the tip of the snout are covered with minute pores and tubercles. There are 10 to 12 vertical black bands along the sides. The posterior margin of the caudal fin is tipped with black.

Remarks on the identity of *Barilius barnoides* Vinciguerra:

In 1889, Vinciguerra described the species from 'Catchin' in Burma, and characterised it chiefly by the absence of the barbels and the third suborbital bone not being in contact with the pre-opercular ridge. Having carefully examined a para-type of *B. barnoides* and studied the illustrated description of the species, I have come to the conclusion that *B. barnoides* cannot be considered as a valid species distinct from *B. barila*. In Vinciguerra's form, as I find from the para-type, both the rostral and the maxillary barbels are present which were somehow overlooked by the author. The accompanying illustration (Text-fig. 13) of the anterior



Text-fig. 13.—Lateral view of the head of a paratype of *Barilus barnoides* Vincig. showing relative positions of the third suborbital bone and the preopercular ridge, ×2.

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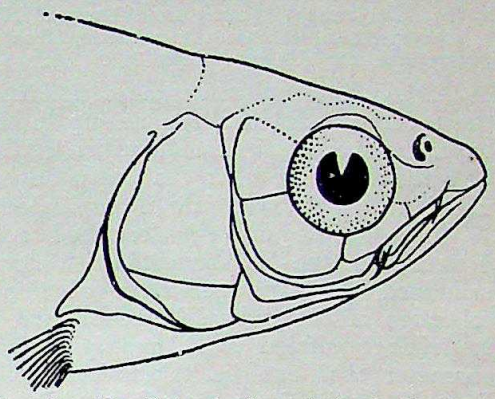
portion of the body of the para-type of *B. barnoides* shows these barbels. The only other character that has been used by Vinciguerra in separating his species from *B. barila* is that in the former the third suborbital bone is not in contact with the preopercular ridge, while in the latter it is said to be in contact. I have examined a large series of *B. barila* of different sizes and from different places and have found that the bones under consideration are very variable in shape and size, etc., irrespective of age and locality; and consequently, their relative positions are also variable. In most cases the third suborbital bone does not lie in contact with the preopercular ridge or according to Day (14, 16) it "nearly" touches the latter (Text-fig. 14). Considering the variability in structures and the relative positions of the third suborbital bone and the preopercular ridge in *B. barila*, I am unable to attach any importance to one bone *touching*, *nearly touching* or *not touching* the other. Leaving aside the questions of the barbels and the position of the third suborbital bone, I find no other character in *B. barnoides* that can be taken into consideration in separating it from *B. barila*.



Text-fig. 14.—Lateral view of the head of one of Day's specimens of *Barilius barila* (Ham. Buch.) showing relative positions of the third suborbital bone and the preopercular ridge, $\times 3\frac{1}{2}$.

In reaching a conclusion regarding the affinity of his species, *B. barnoides*, Vinciguerra seems to have depended considerably on the short and inadequate descriptions of the allied species given by Günther, Day and others, and this induced him to place his species, which he believed to be non-barbelled, closer to the so-called non-barbelled form, *B. barna*, rather than to *B. barila*, characterised so far with a pair of rostral barbels. From the foregoing accounts of *B. barna* and *B. barila* it is, however, clear that they are different from what they have been understood by Günther, Day and others, and their affinities with related species of the genus must, therefore, be different. At the state of our present knowledge of the three species, *viz. B. barna*, *B. barila* and *B. barnoides*, it is not possible to recognise Vinciguerra's species as distinct from *B. barila*.

In 1893 Boulenger (4) relegated *B. barnoides* to the synonymy of *B. ornatus* Sauvage without assigning any reasons for it. As I am not familiar with the form *B. ornatus*, I am unable to make any comment on its affinity with *B. barnoides*. It seems to me probable, however, that Boulenger knew *B. barnoides* only from Vinciguerra's description and figure.

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Danio (Danio) aequipinnatus (McClell.)

One specimen (80 mm.) from Tang Hka: '*Nga bit*'.
Two specimens (61 mm.) from Phungin Hka: '*Salap la's*
One specimen (51 mm.) from Sinan Hka: '*Nga wan*'.
One specimen (30 mm.) from ? : ?

Although at different places different local names are used, all the specimens listed above belong to this species. The specimens have the characteristic colouration of the species and a small flake of a metallic blue near the upper angle of the opercles. In some individuals the lower jaw is papillated.

In 1907, Regan (47) described a new species of *Danio*, *D. browni* from the Northern Shan States in Upper Burma. I have examined the type-specimens of this species preserved in the collection of the Indian Museum, and have found that *D. browni* is strikingly similar to *D. aequipinnatus*. I do not find any stable character that can be taken into consideration in differentiating Regan's species from the other. *D. aequipinnatus* is such a variable species, as I find from an examination of large series of specimens from various places in India, Burma and Siam, that it seems impossible to recognise *D. browni* a distinct form.

FAMILY: BELONIDAE.

Xenentodon cancila (Ham. Buch.).

One specimen (205 mm.) from Tang Hka: '*Singawng tang*'.
One specimen (203 mm.) from Phungin Hka: '*Singawng tang*'.

Two indistinct blackish spots are present above the base of the pectoral fins.

According to the field-notes of Colonel Burton the species is said to grow "up to 3 lbs." The fish is known to grow to a fairly big size. Day (14) observed that it attains at least a foot in length.

FAMILY: NANDIDAE.

Badis badis (Ham. Buch.).

One specimen (40 mm.) from Phungin Hka: '*Nga-teng*'.
One specimen (57 mm.) from Tang Hka: '*Nkrai daw*'.

There are 10 to 11 vertical black bands along the sides. The dorsal fin is tipped with white. The outer margin of the ventrals is blackish.

The species is very variable in respect of the number of spines of the dorsal fin and of the different fin rays. The nature of the lateral line and the colour pattern are also variable.

FAMILY: MASTACEMBELIDAE.

Mastacembelus armatus (Lacép.).

One specimen (140 mm.) from Phungin Hka: '*Nga lapu*'.
One specimen (200 mm.) from Tang Hka: '*Shayu*'.

Both the specimens are young and they belong to the same species, although they are known by different local names. The fish is said to grow "up to 7 lbs."

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FAMILY: OPHICEPHALIDAE.

GENUS: **Ophicephalus** Bloch.

In a recent paper Myers and Shapovalov (44) have shown that in view of the records of occasional absence of the ventral fins in *Ophicephalus gachua* Ham. Buch., *Channa* Scopoli (1777) which has so far been separated from *Ophicephalus* Bloch (1794) chiefly by the absence of the ventral fins cannot be regarded as a phylogenetic entity distinct from *Ophicephalus*, and that according to the relevant rules of the Zoological Nomenclature, the name *Ophicephalus* must be superseded by *Channa*. Although I thoroughly agree, as one must, with the views of Myers and Shapovalov I am for the present retaining *Ophicephalus* for its being an eminently suitable and so very well-known a name. Recently Herre (21) has also retained this name.

Ophicephalus gachua Ham. Buch.

One specimen (147 mm.) from Phungin Hka: *'Khumpup Nga'*.

The species is perhaps the hardiest of all its relatives. It has been observed by Deraniayagala (17) that "*Ophicephalus gachua* flourishes in ponds rendered so stagnant as to prove toxic to most fishes. The swarms of tadpoles and mosquito larvae which thrive in these ponds supply food for the adults and fry respectively. The fish is very hardy and exceedingly active on land, progressing by series of leaps. It propels itself into the air by bending its body, planting its tail on the ground and straightening itself with a jerk, and it is a common sight to find these fishes crossing overland, while the pond they inhabit is baled dry by villagers in search of fish". It has also been found in Ceylon to be able to "withstand a considerable range of temperature from the warm waters arising from the hot springs at Kanniya (E. P.) to the cold waters of Diyatalava (U.P.)".

According to the field-notes of Colonel Burton the species grows "up to 2 lbs." This requires confirmation. So far as I am aware the fish hardly attains that size and Day's remarks about its attaining "at least 13 inches" is probably an over-statement.

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THE GAME BIRDS AND ANIMALS OF THE MANIPUR STATE WITH NOTES OF THEIR NUMBERS, MIGRATION AND HABITS.

BY

J. C. HIGGINS, I.C.S.

PART IV.

(*Continued from page* 854 *of volume* xxxvi).

BUSTARDS.

The Bustard of Assam (*Sypheotis bengalensis*) is not found in Manipur, and I have never seen or heard of a straggler of any species.

PLOVERS.

The Eastern Golden Plover (*Pluvialis dominicus fulvus*)—Manipuri, *nonggāng*.

Regarding the Golden Plover, Baker[1] says that they appear in Assam in late August, or September, and leave in April. 'Raoul'[2] notes that they reach Bengal in August. In Manipur they arrive and leave just a little later than the Pintail Snipe. The earliest recorded in the bag was shot on August 13th (1913), and I actually saw two on August 7th of the same year. I have shot them on May 13th (1917) and May 14th (1932): and my shikaris have reported them on May 20th (1917), May 29th (1932), and a flock of six as late as June 9th (1932). They are seen annually in August and in May.

In the migration seasons, the Golden Plover is found in flocks, occasionally as large as 200 or 300, on grazing grounds, the edges of *bils*, and in fallow paddy fields, dry or not too wet. In the cold weather most of them seem to disappear, though a few flocks remain on the larger *bils*, where they rest on the islands and feed round the edges. The best year's bag is 83, in 1923-24, and good days (largely contributed to by 'browning' flocks on *bils*) were:—

14-3-20	... 44
3-3-14	... 25
28-9-14	... 24

The Golden Plover is a curious mixture of simplicity and cunning. The flock invariably puts out one or more sentries, and, unless cover is available, which they usually take very good care there is not, it is difficult to approach them. But I have often

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[1] *The Game Birds of the Indian Empire*, vol. v, *J.B.N.H.S.*, vol. xxxv, 1, p. 5.

[2] Op. cit., p. 29.

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employed Baker's device of driving them, with success, and it is extraordinary how, once on the wing, they will often fly straight past or over the guns, even when walking up snipe and making no attempt at concealment.

As a table bird, I personally prefer the Golden Plover to the snipe, though I have found very few to agree with me, except 'Raoul.'[1] It is probable, however, that they would pall sooner than snipe as a continued diet.

The Lapwing, Peewit or Green Plover (*Vanellus vanellus*).

A very rare visitor. Five were shot on November 29th, 1916, on a grazing ground. I saw 2 on the edge of the Loktak lake on December 26th, 1920, and Colonel Goodall saw a large flock on a *bil* north of the Loktak on February 13th, 1930.

The Spur-winged Plover (*Hoplopterus duvaucelii*)—Manipuri, *ngāhoibi* ('fish-chaser'), the same name as is applied to the Red-shanks.

This species is resident and breeds. It is found on the shingle beds and sandbanks in streams in or near the hills, and is not particularly common. It is only shot occasionally for the pot, as it is tame and flies so slowly that it can hardly be regarded as an object of sport.

I have never heard them call 'did he do it?', as Baker[2] says they do. The usual call is one sharp note, several times repeated, ending with three staccato notes.

The Burmese Red-wattled Lapwing (*Lobivanellus indicus atronuchalis*)—Manipuri, *salangkāk*.

This species resides and breeds, but not in very large numbers. It is shot seldom, for the pot, being tame and a poor flyer.

The Grey-headed Lapwing (*Microsarcops cinereus*)—Manipuri, *salang*. In the Journal[3] I wrongly ascribed this name to the Yellow-wattled Lapwing (*Lobipluvalia malabarica*), which does not occur in Manipur.

This species is migratory, but I have never observed the seasons of migration. Baker[4] says he 'never came across them in flocks, but generally singly and occasionally in pairs'. In Manipur they are almost invariably in flocks, sometimes as large as 50 birds, both on the grazing grounds, as well as on the wet ground round marshes and on the *bils*.

The Eastern Grey Plover (*Squatarola squatarola hypomela*).

Mr. L. O. Clarke, I.C.S., records that one was brought in to him on October 17th, 1921. It had been killed by a kite.

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[1] Op. cit., *J.B.N.H.S.*, vol. xxxv, 1, p. 33.
[2] Op. cit., *J.B.N.H.S.*, vol. xxxv, 2, p. 243.
[3] *J.B.N.H.S.*, vol. xxviii, p. 290, 'Manipuri Names of certain birds'.
[4] Op. cit., p. 253.

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The Turnstone (*Arenaria interpres interpres*).

I shot one on September 28th, 1914, on a grazing ground, the identification being confirmed by the Society. I have never seen it before or since.

The Indian Stone-Plover (*Burhinus oedicnemus indicus*).

I have only once met with this bird—a single specimen, shot on September 6th, 1932.

The Great Stone-Plover (*Esacus recurvirostris*).

These birds arrive just before the Pintail Snipe and only stay until September, being found only on the grazing grounds. They appear regularly every year, and I have seen them as early as July 29th. They are found in small parties (I have seen as many as 14 together) and seem to be particular as to the localities they frequent. On some grazing grounds they never fail to appear, while on others, apparently equally suitable, they are never seen. Presumably they halt on their migration, but I have never seen them on the backward migration. In Manipur they are easy to approach, but are seldom shot.

The Large Indian Pratincole or Swallow-plover (*Glareola maldivarum maldivarum*).

I have only once noticed these birds. Mr. C. F. Jeffery shot one out of a small flock on August 16th, 1931. It was identified by the Society and recorded in the Journal.[1]

OTHER WADERS.

Cranes.

The Hooded Crane (*Grus monachus*)—Manipuri, *woinumāl* ('like a sarus'). In the Journal[2] I wrongly ascribed this name to and identified the bird as the Eastern Common Crane (*Grus grus lilfordi*), but from Baker's[3] notes it is clear that the crane of Manipur is *G. monachus*.

This bird is a regular visitor to Manipur, though not in large numbers. They are very wary and none have been shot of late years. But Colonel Cassels records 6 having been shot on December 31st, 1897 and January 1st, 1898. I once hit one, but failed to retrieve it, as it fell a long way off: this is the only shot I have ever had at them. The earliest by far that I have seen them was on September 29th, 1930. They appear to leave early, as I once watched a flock circling to gain elevation in order to cross the western range of hills: I cannot recollect the exact date, but it was certainly before the end of February.

The Burmese Sarus (*Antigone antigone sharpei*)—Manipuri, *woinu, woinuren* ('the large *woinu*').

This species is not uncommon, residing and breeding in the swamps in the south of the valley: but it is not shot. They are

[1] *J.B.N.H.S.*, vol. xxxv, No. 3, p. 686.
[2] *J.B.N.H.S.*, vol. xxviii, No. 1, p. 290.
[3] *Fauna of British India*, vol. vi, p. 52.

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usually seen in pairs, but I once met with a large flock of between 20 and 30. Finn[1] mentions the tendency to collect in flocks as one of the characteristics distinguishing this subspecies from *G. a. antigone*.

GULLS.

There is only one gull in Manipur (Manipuri, *taotra*) which is common on the lakes in the cold weather. It is fond of associating with the coots (*Fulica atra atra*) and the dabchicks (*Podiceps ruficollis capensis*) and may be seen leading a party of the latter about, like a school. I have never identified it, but it is probably **The Brown-headed Gull** (*Larus brunnicephalus*).

TERNS.

There are several varieties of terns, which I have never identified. The Manipuri name for them is *ngārākpi* ('fish-catcher'), which is also the term for kingfishers. A smaller variety is also known as *pāt chekpi* ('the lake flying-fox').

The Avocet (*Recurvirostra avocetta avocetta*).

Baker[2] says of the Avocet that 'eastward it has occurred as far as Behar'. I once saw a pair in Manipur (date not recorded), and my shikari once shot one and brought it in to me. He has reported seeing it occasionally since (twice, I think, but I cannot be certain, having kept no records). However, there can be no doubt that it is an occasional visitor. Primrose[3] also recorded it from the Goalpara district of Assam in 1908.

The Eastern Curlew (*Numenius phœopus variegatus*).

A rare visitor. I shot one out of a pair on October 6th, 1926, and Major E. R. Daboo, I.M.S., shot a single bird on September 10th, 1930. I saw a single bird on December 30th, 1925, another on February 6th, 1930, and three on October 12th and November 2nd, 1930 (probably the same birds, as they were on the same *bil*).

The Eastern Whimbrel (*Numenius phæpus variegatus*).

A single bird was shot by Captain Bulfield on August 25th, 1932.

SANDPIPERS.

There are numerous kinds which I have never identified. The Manipuris call them *chessā*, *chegaibi*, the former being the name used by the Muhammadans and the latter by the Hindus.

The Redshank (*Tringa totanus*)—Manipuri, *ngāhoibi* (cf. the Spur-winged Plover).

A regular visitor. I have never examined the few shot to see whether they are *Tringa totanus totanus* or *T. t. terigontæ*.

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[1] *How to know the Indian Waders*, p. 81.
[2] Op. cit., *J.B.N.H.S.*, vol. xxxv, 3, p. 479.
[3] *J.B.N.H.S.*, vol. xviii, 3, p. 683.

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The Spotted or Dusky Redshank (*Tringa erythropus*) Manipuri, *ngāhoibi*.

A regular visitor, seen in large flocks. It is a very swift flier.

The Ruff and Reeve (*Philomachus pugnax*).

This is an uncommon, though not infrequent visitor. Five have been shot, the identification of two of which was confirmed by the Society.

The Spotted-billed Pelican (*Pelecanus philippensis*)—Manipuri, *uphong*.

A fairly common visitor. They appear at the end of the cold weather and leave again after the rains.

Cormorants.

The Indian Shag (*Phalacrocorax fascicollis*)—Manipuri *urā okmāl* ('cormorant like a pig') is found, also the Large Indian Cormorant (*Phalacrocorax carbo sinensis*)—Manipuri *urā pongyai*: these two species migrate. The Little Cormorant (*Phalacrocorax niger*)—Manipuri, *urā khomdol*, is common and breeds. The shikaris always declare that there is a fourth species, which they call *urā mitsang* ('green-eyed cormorant'), which is a little larger than *urā khomdol*, and resides and breeds. Doubtless this is also *P. niger*. The Indian Darter (*Anhinga melanogaster*)—Manipuri, *urā limāl* ('cormorant like a snake') resides and breeds.

Ibises.

The White Ibis (*Threskiornis melanocephalus*)—Manipuri, *māyāng urok* ('the foreign egret' or 'the Cachar egret') is not uncommon. More plentiful is the Glossy Ibis (*Plegadis falcinellus falcinellus*)—Manipuri, *kaksu*, (In the Journal[1] I wrongly classified this bird as the Black Ibis, *Pseudibis paillosus*).

Storks.

There are only two storks in Manipur. **The Open-bill** (*Anastomus oscitans*)—Manipuri, *thāroichābi* ('*snail-eater*') or *pāmjenj* (used only by the Hindus)—is very common, being seen in immense flocks and breeding. In the Journal[2] this name was wrongly assigned to the Spoonbill (*Platalea leucorodia major*), which I have never seen in Manipur. The Black-necked Stork (*Xenorhynchus asiaticus asiaticus*), which was formerly found occasionally is now scarcely ever seen. The 'Fauna of British India' records the Eastern White Stork (*Ciconia ciconia boyciana*) as found in Manipur, but I have never seen it.

Some at least of the Open-bills migrate, though many are to be seen at all times of the year. On November 12th, 1926, when returning through the hills from Burma, I saw a very large flock circling round and round to gain elevation before crossing the

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[1] *J.B.N.H.S.*, vol. xxviii, No. 1, p. 289.
[2] *Loc. cit.*

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watershed between the Manipur and Chindwin basins—4,750 ft. at that point.

Herons.

The Eastern Purple Heron (*Ardea purpurea manillensis*)—Manipuri, *utsai saingāng* ('red-cheeked heron').

This species, which is fairly common, resides and breeds.

The Eastern Grey Heron (*Ardea cinerea rectirostris*)—Manipuri, *utsai saingou* ('white-cheeked heron').

Slightly less common than the preceding. It migrates to breed, but returns early, as I saw a pair on August 17th, 1930.

Egrets.

The generic Manipuri term for the Egrets is *urok*.

The Eastern Large Egret (*Egretta alba modesta*)—Manipuri, *urok loklenbā* ('the egret which walks in streams'): **The Indian Smaller Egret** (*Egretta intermedia intermedia*)—Manipuri, *langkhongsang* (*khongsang* means 'long legs'): **The Little Egret** (*Egretta garzetta garzetta*)—Manipuri, *naokang;* and **The Cattle Egret** (*Bubulcus ibis coromandus*)—Manipuri, *urok sandungil* ('the egret which follows after cattle') all reside and breed.

Pond Herons.

The Indian Pond-heron (*Ardeola grayii*)—Manipuri, *lamprā*.

This species is common, residing and breeding.

The Chinese Pond-heron (*Ardeola bacchus*)—Manipuri, *lamprā amubi* ('the black pond-heron').

This species is not so common as the preceding one, but is far from rare.

The Indian Little Green Heron (*Butorides striatus javanicus*)—I am not certain as to the vernacular name, but I think it shares *wākhambong* with certain of the bitterns.

Not uncommon, especially in hill streams, where they debouch into the Manipur valley.

The Night-Heron (*Nycticorax nycticorax nycticorax*)—Manipuri, *chongkhu*.

Common: resides and breeds. My shikari declares there are three varieties of night-heron. The other two are known as *chongkhu hawaimān* ('the spotted night-heron') and *tourak chongkhu* ('the reed-bed night-heron'), from its habitat. I have not been able to investigate this statement.

Bitterns.

The Malay Bittern (*Gorsakius melanolophus melanolophus*): The Yellow Bittern (*Ixobrychus sinensis sinensis*): The Chestnut Bittern (*Ixobrychus cinnamomeus*): and The Black Bittern (*Dupetor flavicollis flavicollis*) all occur. The three former are known in the vernacular as *wākhambong*, and the last as *honglai amubi* ('the black rail').

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GREBES.

The Great Crested Grebe (*Podiceps cristatus cristatus*)—Manipuri, *kumphengbi.*

This species is fairly common.

The Indian Little Grebe (*Podiceps ruficollis capensis*)—Manipuri, *upum.*

Very common.

COOTS.

The Common Coot (*Fulica atra atra*)—Manipuri, *porom.*

Very common. It is migratory, and the Manipuris say that it comes with the Pochards, but leaves before them.

The Indian Purple Coot (*Porphyrio poliocephalus poliocephalus*)—Manipuri, *umu.*

This species is less common, but is found in suitable localities. It resides and breeds.

WATERHENS.

The Chinese White-breasted Waterhen (*Amaurornis phœnicurus chinensis*)—Manipuri, *uren konthou*: **The Kora or Watercock** (*Gallicrex cinerea*)—Manipuri, *utum;* and **The Indian Moorhen** (*Gallinula chloropus parvifrons*)—Manipuri, *pāt uren* ('the lake waterhen')—all reside and breed.

JACANAS.

The Bronze-winged Jacana (*Metopidius indicus*)—Manipuri, *thamnāchenbi* ('running on the lotus leaves'), and **The Pheasant-tailed Jacana** (*Hydrophasianus chirurgus*)—Manipuri, *yempārābā* ('male fowl') both reside and breed.

RAILS AND CRAKES.

There are a number of these, which I have never identified. The Manipuri generic name for rails is *honglai.*

PHEASANTS.

The Manipur valley (except in the swamps, which are unsuitable) is too thickly populated and devoid of forest to be the abode of the pheasant tribe. In the forest-clad hills of the State they are fairly plentiful, and a few are shot every year in the glens which run back into the hills from the main valley. Very little shooting is done in the hills proper, as the jungle is too dense, and game is not sufficiently thick on the ground to make organised driving worth while.

The best year's bag is 67, in 1928-29.

The Burmese Peafowl (*Pavo muticus*)—Manipuri, *wāhong.*

This species used to be fairly common in the Manipur hills,[1] but is now practically extinct. The male of a pair flushed in the

[1] *Fauna of British India*, vol. v, p. 284.

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extreme north of the Manipur valley was shot on January 28th, 1928. The only other record I have of these birds is the report of a hen being seen near the same spot 2 or 3 years earlier (possibly the same bird).

The Common Peafowl (*Pavo cristatus*)—Manipuri, *wahong*.

His Highness the Maharaja has some pairs at the Palace, the offspring of which have run wild over the country to some extent, and have reached the hills east and north of Imphal. It will be interesting to see whether they will be able to establish themselves and replace the extinct Burmese race by the Indian.

The Bhutan Peacock-pheasant (*Polyplectron bicalcaratum bakeri*).

This bird is fairly common in the hills, especially in the evergreen forest of the west. In the valley of the Makru river I have heard numbers calling in the early morning of mid-March. They are seldom shot, as they are difficult to find and flush.

Baker[1] describes the call notes as 'a deep, guttural "hoo", rapidly repeated, and a large vocabulary of soft chuckling notes'. The commonest call may be rendered 'ok-kok-kok-kok', and is not unlike that of the English cock pheasant.

The Common Jungle Fowl (*Gallus bankiva murghi*)—Manipuri, *lamyel* ('wild fowl').

I have never examined the birds I have shot with a view to identifying them as *G. b. murghi* or *robinsoni*, but Baker[2] gives Assam as the habitat of the former and Burma of the latter subspecies. Probably the two overlap in Manipur, as do the Black and Chinese Francolins. Incidentally the new mongrel scientific name for this species is hardly an improvement on those which it has displaced.

The Jungle-fowl is common in the hills, especially in the foothills of the Kabaw valley (Burma), and in the valleys of the Barak and its tributaries, the Jiri, the Makru and the Irang, on the Cachar border. It is fairly plentiful in the glens running off the main valley of Manipur, where, with the Kalij and a few snipe and woodcock it forms a welcome addition to the bags of Black and Bamboo Partridges made in the spring. The best year's bag of Jungle-fowl, made in 1928-29, is 56, of which 49 were shot in the Manipur valley. The best day's bag is 13, shot on January 28th, 1928, by two guns. In the Kabaw valley of Burma, just at the foot of the hills which form the Manipur border, 45 were shot in three days in January, 1925, though this is not a large bag for the Upper Chindwin district, in which that valley is situated.

Mrs. Hume's Pheasant (*Syrmaticus humiæ humiæ*)—Manipuri, *loiningkoi*, *noining* ('l' and 'n' are interchangeable). The name *nongin*, found in various books and articles, is a local name for the

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[1] *Fauna of British India*, vol. v, p. 291.
[2] *Game Birds of India, Burma and Ceylon*, vol. iii, pp. 133, 148.

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bird, but is not Manipuri but Chiru (one of the tribes inhabiting the hills near the valley).

The range in Manipur given by Hume—'from 2,500 ft. (the height of the lower end of the Manipur plain) to fully 5,000 ft.' is discredited by Baker,[1] on the ground that he could not find the bird in the Jiri valley, which forms the boundary between the Manipur and North Cachar hills on the west of the State. But from the information I have collected, Hume's description is fairly accurate, and Baker's failure to procure one was doubtless due to the fact that the habitat of every bird must end somewhere and the Jiri valley possibly happens to be outside the western boundary of the range of this species. Personally, though I have frequently searched and driven likely places, I have only seen the bird twice. The first occasion was during the rains, at Ukhrul in the eastern hills, just below 6,000 ft. The second was in January, 1918, when the flankers of a column I was out with put one up at Heika (4,700 ft.), in the southern hills. This bird rose out of long grass and dropped at the edge of the strip of forest, down the hill. I did not pursue it, as the Kukis against whom we were operating had been sniping us on the way up the hill. The shikaris report that it is often seen in the valley of the Thoubal river, a tributary of the Manipur river from the eastern hills, at an elevation of 2,700 to 2,900 ft., as late as March. I have had several beats in likely places, but have found nothing except Kalij and partridges. How far it extends into the western hills I do not know. That it does occur there is certain, as the Kukis of the south-west bring in the tail feathers, which form part of the head-dresses of the Manipuri officials, boatmen and dancers, and Mr. J. Needham, I.P., shot a number in the Irang valley in 1918-19. But between the Irang and the Jiri, where Mr. Baker looked for them, lie the valleys of the Barak and the Makru, and three ranges of mountains, one very precipitous and running up to over 9,000 ft.

The Black-breasted Kalij Pheasant (*Gennaeus horsfieldii horsfieldii*)—Manipuri, *wābā*.

As Baker[2] says, this species is 'the common pheasant' of Manipur. But it nowhere occurs in the same numbers as the Junglefowl, and escapes being bagged because it is an inveterate skulker and very difficult to flush. The best year's bag is 15, in 1926-27.

In a few Manipuri villages in the main valley, where there are sacred groves belonging to the ancient non-Hindu deities, a few Kalij are to be found. There are quite a number on Thanga, a hilly island in the Loktak, covered with scrub and bamboo, with a Manipuri village along the water's edge. Village Kalij are, needless to say, filthy feeders and quite unfit for the table.

William's Kalij Pheasant (*Gennaeus horsfieldii williamsi*).

I was shown the feathers of a Kalij shot in January, 1929, at Karong in the Barak valley, 40 miles north of Imphal, at about 3,500 ft., by Mrs. A. A. Barnard, which were almost certainly

[1] Op. cit., p. 179.

[2] Op. cit., p. 270.

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those of a male of this species. About a month later, while driving through the hills, I put up a Kalij in almost exactly the same place, which was grey on the head, back and wings, and was presumably another of this species. Baker[1] gives its habitat as 'east of the Manipur river', but all the localities he specifies are in Burma, so presumably it has not been recorded from so far north and west as Manipur. Doubtless this and the preceding species overlap very considerably, as *G. h. horsfieldii* is certainly common for a long distance south of Karong, and has been found in the Chin Hills, at least 100 miles further south, as the crow flies, by Hopwood and Mackenzie,[2] and by Blandy.[3]

Apparently Beebe does not admit *G. h. williamsi* as a subspecies at all, but 'relegates it to the wild hybrids'.[4] This does not seem probable, as I am almost certain that *Gennæus lineatus* does not occur in the State, and it can be taken as certain that the Karong birds could not have strayed some 100 to 200 miles from the *lineatus* parent.

The Grey-bellied Horned Pheasant (*Tragopan blythi blythi*). I cannot ascertain the Manipuri name. Probably the Manipuri, being a man of the valley, does not know this bird.

They are found only in thick forest in the higher ranges, both east and west of the valley. Only one has been recorded, on February 14th, 1928. But Colonel Cassels shot 2 in 1894 and 1 in 1896, and the sportsman who shot the bird recorded in 1928 said that he got another in 1926.

Partridges.

Five species are known to occur in Manipur. The local open season sanctioned by the Darbar in from September 1st to March 31st, but very few are shot before Christmas, as the grass and jungle are too thick. The best year's bag, in 1925-26, is 712, made up of 578 Black Partridges, 11 Chinese Francolins and 123 Bamboo Partridges. The percentages of various species in the total bag is:—

Black Partridges	...	87·29 per cent
Chinese Francolin	...	·79 ,,
Bamboo Partridges	...	11·76 ,,
Hill Partridges	...	·16 ,,

The Assam Black Partridge (*Francolinus francolinus melanonotus*). —Manipuri, *urenbi*, not '*kembi*', as given by Baker,[5] or '*vrembi*', by Finn.[6]

This bird is very common in suitable localities. The best country is found along the foot of the hills surrounding the Manipur valley, particularly on the west and south-west. It is scarce near

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[1] Op. cit., p. 284.
[2] *J.B.N.H.S.*, vol. xxv, 1, p. 91.
[3] *J.B.N.H.S.*, vol. xxvi, 1, p. 289.
[4] Inglis, *J.B.N.H.S.*, vol. xxviii, 4, p. 1118.
[5] Op. cit., p. 202: *Fauna of British India*, vol. v, p. 411.
[6] *Indian Sporting Birds*, p. 230.

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Muhammadan villages, as the Manipuri Muhammadan runs it down with dogs, as Travers[1] says the Santals do. It is uncommon in the hills, though it occurs where the valleys and hill sides are open and grassy, as in the upper valley of the Barak. In the western hills, which are mostly covered by evergreen forest and bamboo, it is rare beyond the first range, where the foothills are grassy. In the eastern hills I have seen it in the Iril, Thoubal and Tuyungbi valleys, and as far as Ukhrul, where I put up a bird at 6,000 ft. This village is 34 miles north-east of Imphal, and only 40 miles from the Chindwin river. Elsewhere in the eastern hills I have heard the Chinese Francolin (*F. pintadeanus phayrei*) calling in a number of places, extending as far north as Phuntret (Jessami) in the extreme north-east corner of the State, and I am unable to say what is the boundary between the habitats of the two species. Presumably they overlap in the hills as they do in the Manipur valley. I do not think the Black Partridge extends to the Kabaw valley, across the Burma border. I have visited it on seven occasions, between January and May, spending in all nearly three months in camp in the valley, from the extreme north to the south, and I have never heard the Black Partridge calling there.

In numbers this bird is on the decrease, though slowly. This is due not so much to its being shot out (though this has undoubtedly affected some localities) as to the increase of population and spread of cultivation. The Black Partridge, like his English cousin, is very definitely a bird of cultivation; but in addition he must have water and his little bit of cover to which to retire during the day, and if the latter is destroyed, he moves on elsewhere. The best year's bag is 578, in 1925-26, and good days were:—

25-12-20	...	75
29-12-24	...	75
26-12-25	...	67
16-2-19	...	61
29-12-25	...	60

The home of the Black Partridge is essentially grass, preferably not too long: it is also necessary that the grass should not be so thick as to prevent the birds from running freely. They are not infrequently found in low oak scrub, and they like grassy groves of silk-cotton (*Bombax malabaricum*). In a well-watered country, like Manipur, they are never found very far from water.

They are great runners and may be seen running rapidly in front of the beaters in open pieces of burnt cover. Birds will, as often as not, run to the end of a piece of cover which has not been burnt, where five or six will rise and fly in all directions, frequently back over the line. The Black Partridge is a tame bird and not a very fast flier (though Baker[2] says that it flies

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[1] *J.B.N.H.S.*, vol. xxvii, p. 154.

[2] 'Game Birds of India, Burma and Ceylon', *J.B.N.H.S.*, vol. xxvii, 2. p. 199.

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strong and straight), and is very easy to shoot. I fear that very few flushed escape unwounded.

The call, which is intermediate between a hiss and a whistle, consisting mostly of notes not unlike those of a snipe, has been variously described. Baker[1] represents it as *che-chirree chick chiree*, with the accent on the *chick* and the final syllable: he quotes the Muhammadan version as *subhan tere kudrut*. Finn[2] refers to the call as consisting of 'about half a dozen syllables', and quotes Hume as saying that *be quick, pay your debts* is the best English version. The Manipuri version is *mi taret, thāng taret* ('seven men, seven daos'), referring to a folk-tale which ascribes the origin of the bird to a man who was set on and killed by seven rivals in the jungle. What is strange is that no one appears to have noticed that the call consists of *seven* distinct syllables, not six or five; the first being separated from the rest and very short and sharp. This may be due to the fact that the first syllable is so sharp as to be far less audible than the rest. Indeed, some persons find difficulty in hearing the call at all, and I knew one man, whose hearing was normally perfect, who was completely deaf to the call of a bird sitting even a few yards away. The whole call may be represented as '*tk*: *pss ps-wss ps-wss-wss*', with a pause after the first, second and fourth syllables, which are accented.

The Black Partridge, as Baker[3] and Finn[4] observe, pairs remarkably early in the cold weather, as soon as the young birds are mature, and if a cock is flushed it is always worth while looking for the hen in the vicinity, or vice versa. The cocks are more confirmed runners and harder to flush than the hens.

As a table bird, properly hung, I have always found the Black Partridge excellent and well worth roasting (pace Baker[5]). 'Raoul'[6] appears to agree with me.

The Eastern or Chinese Francolin (*Francolinus pintadeanus phayrei*)—Manipuri, *kabo urenbi* ('the Kabaw partridge'), not '*wrengbi*'[7] or '*urengbi*',[8] as given by Baker.

The Chinese Francolin was, I think, never recorded as an inhabitant of Manipur in any scientific or semi-scientific books or papers, until my note in the Journal of 1914,[9] though Colonel Wilson[10] writes, 'the painted francolin or Burmese partridge was found in the tree jungle near cultivation', doubtless referring to this species. I had just made its acquaintance (May, 1914) on my first visit to the Kabaw valley, and was very surprised to find

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[1] Op. cit., *J.B.N.H.S.*, vol. xxvii, 2, p. 199.
[2] Op. cit., p. 231.
[3] Op. cit., p. 199.
[4] Op. cit., p. 231.
[5] Op. cit., p. 206.
[6] Op, cit., p. 48.
[7] Op. cit., *J.B.N.H.S.*, vol. xxvii, 3, p. 420.
[8] *Fauna of British India*, vol. v, p. 415.
[9] *J.B.N.H.S.*, vol. xxiii, 2, p. 368.
[10] *Sport and Service in Assam and Elsewhere* (1924), p. 177.

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it calling in the foothills of the south-east corner of the Manipur valley, on my return journey. Its distribution in the Manipur valley appears to commence from the glen of the Khuga river (in the south-west corner of the valley), whence it follows the foothills in the south-west, south and east of the valley as far north as Pukhao, in the glen of the Iril river, in the extreme north-east corner of the valley. It has never been recorded or heard north of Kangwai (Survey of India Sheet 83 H/SE, C1) on the western foothills, and Yumnam Khunou (83 H/NE, F1) on the eastern foothills, although the country round the hills in the west and north of the valley has been extensively shot over. It does not frequent the isolated low ranges of hills in the Manipur valley itself. In the hills, I have no knowledge of its occurrence anywhere west of the Manipur and Khuga valleys. It occurs throughout the southern hills, east of the Khuga valley, and in suitable localities in the eastern hills, where I have heard it calling near Chakpi Karong (83 H/SE, E4) and Lambung (83 L/SW, A3), in the valley of the Chakpi: near Sibong (83 L/SW, D3), in the valley of the Lokchao; Khonglou (83 L/NW, F5), in the valley of the Maklang: between Sareikhong (83 L/NW, C1) and Chandrakhong (83 L/NW, B4), in the valleys of the Thoubal and Itok: and near Jessami (83 K/NE, A5) and Wahong (83 K/SE, A1), in the valley of the Viratai. It is possible that it may occur elsewhere in this part of the hills.

The Chinese Francolin is nowhere so plentiful as the Black Partridge, and is not bagged very frequently, as, unlike the latter, it rarely leaves the low oak scrub on the foothills, where the going is laborious and beating difficult. Moreover, it is harder to flush than the latter, and has a disconcerting habit of perching in a high tree and allowing the trouble to pass underneath it. When flushed it is a far stronger flier than the Black. The best day's bag made in the Manipur valley is 5, on March 24th, 1929. I obtained these birds (all I saw), with only 4 beaters and no dog, by marking their call and beating the neighbouring scrub. In the Kabaw valley I once bagged 6 (out of 9 flushed), with ten beaters and a Springer bitch (worth all the beaters put together), in a small grassy stream, surrounded by *'in'* (*Dipterocarpus tuberculatus*) forest. Over the same ground three years later, with 30 beaters and no dog, I flushed two and shot one. The best year's bag is only 11, in 1925-26 (5 in the Manipur valley), and in 1928-29 (10 in the Manipur valley); and only 48 have been shot in all.

The descriptions of its call given by Baker[1]—*'ke kai, ke kai, ke karr'*, or *'kai kai, kee kai, kee karr'* (Swinhoe), and *'hing puh tiy yay, ko ko'* (Chinese)—afford little idea of the actual sound, though they give an indication of the rhythm. The same applies to the Manipuri version—*'aigi pôt kadai?'* ('where are my things?')—said to be the lament of a traveller to Burma who was set upon by dacoits and robbed, and subsequently changed into this bird—a curious link with the Black Partridge. But Wardlaw Ramsay's

[1] *Fauna of British India*, vol. v, p. 415.

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version, quoted by Finn[1]—*'kak kak kuich, kā kā'* strikes me as being remarkably near to it. With the exception of the Manipuri, the others do not appear to have noticed that there are five notes in the call, not six. For a partridge it is a strangely resonant call.

In describing this species, it does not seem to have been noted that it possesses a far heavier head and thicker neck, in proportion to its size, than the Black Partridge.

In view of the fact that Baker[2] records that 'hybrids between the Black and Painted Partridges are very common, as one might expect between two game-birds so closely connected, whose habitats overlap', it is strange that none appear to have been recorded between the Black and the Chinese Francolin. I have always been on the lookout for them, but have never seen a bird which might be suspected of being a hybrid, though the Black Partridge is common in all the localities in the Manipur valley where the Chinese Francolin is found.

The Assam Bamboo Partridge (*Bambusicola fytchii hopkinsoni*)—Manipuri, *wākrek* (*wā* meaning 'bamboo', *-krek* presumably representing the bird's alarm call, when flushed).

The Bamboo Partridge is common throughout the hills, ascending to a fair altitude, like the Black Partridge. I put up a party of 11 at 6,000 ft. in the northern hills, on March 20th., 1932. I know of one Manipuri village in the middle of the valley, where there is a covey, and a few are found in villages as far as two miles from the hills. It is only in such villages that I have ever seen a Bamboo Partridge anywhere in the neighbourhood of a bamboo. They seem to avoid bamboo jungle in favour of the hill partridges (*Arborophila*), though Finn[3] mentions it as one of their haunts. In the Manipur hills, few of the streams are without at least one covey, and they are fairly common in all the glens off the main valley, being particularly fond of the willow (*Salix tetrasperma*) thickets on the banks of the streams. The best locality is in the upper waters of the Manipur river itself, as far south as Kanglatongbi, where they are found in the low oak scrub on the banks of the tributary streams, and in the mixture of elephant grass, raspberry bushes, oak and willow along the main stream: they are particularly fond of the grass known in Manipuri as *'pullei'* and in Assamese as *'tārapāt'*—a wild cardamum. In this neighbourhood one may put up 50 to 100 birds in a day. The best bag is 128, made in 1928-29, and good days were:—

16-3-30	... 27
14-3-29	... 23
28-3-32	... 20

The Bamboo Partridge is a strong straight flier when flushed. Finn[4] credits it with being 'generally found in pairs'. This is not the case in Manipur: it is almost invariably found in coveys, and, unlike the Black Partridge, does not pair until March is

[1] Op. cit., p. 235.
[2] Op. cit., p. 419.
[3] Op. cit., p. 221.
[4] Op. cit., p. 222.

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well in, and not always before the end of the month. Wickham[1] confirms this, saying that this species 'keeps in coveys'. Finn[2] says further that the Bamboo Partridge 'perches freely'. I have beaten them out of bushes, and on one occasion saw a bird take refuge in a high tree, where it most effectually disappeared and could not be dislodged. But they are nearly always found on the ground, and are not such perchers as the Chinese Francolin.

Wickham's description of their calls as 'a curious chatter', which is quite musical, and a 'scream', when flushed, is accurate. The 'chatter' has been rendered by Baker[3] as '*chi chirree, chi chirree chi chirree*': it sounds to me more like '*pishup, pishup, pishup, pishup, pishup . . .*' (and so on indefinitely).

A day after Bamboo Partridge in the Manipur glens, with two guns, ten or fifteen beaters, and a couple of dogs, is difficult to beat, even in England. At 2,500 ft. the climate is never too hot, up to the end of March, when the partridge shooting closes. The birds, good movers, almost invariably fly for one or both of the hillsides, across the guns. The bag is varied with an occasional Black or Hill Partridge or Chinese Francolin, teal, snipe, woodcock, jungle-fowl, kalij, quail and barking-deer, and, on a good day, may number as many as 50 or 60 head. The going, apart from an occasional swamp, or a thicket of thorns or raspberry bushes, is good.

The Hill Partridges.

Both the Arakan Red-throated (*Arborophila rufogularis intermedia*) and the White-cheeked Hill Partridge (*A. atrogularis*) have been shot, though rarely. They are not uncommon in the hills—indeed, in places quite the reverse—but are great runners, hard to approach and equally hard to drive in the right direction. I have heard two very distinct calls. One, which Baker[4] accurately describes as '*wheea-whu*', is usually repeated two or three times, followed by a series of three short sharp whistles, '*whu-whu-whu*', in an ascending scale. This, the commoner, which I have also heard in Cachar and Nowgong, nearly as far as the Brahmaputra, is presumably the call of *A. atrogularis*. I have spent several profitless evenings trying to approach one of a large number uttering this call, in various parts of the hills. The other call, a much shorter and softer whistle, which I cannot describe, is probably the call of *A. rufogularis intermedia*. I have never noticed particularly in what localities the two calls are heard, but have heard the two at the same time, both in the western and the southern hills.

I have never been out after Hill Partridges in the north-western hills and have no knowledge of whether the Common Hill Partridge (*Arborophila torqueola torqueola*) occurs, as Baker[5] thinks it probably does.

(*To be continued*).

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[1] 'Notes on the Birds of the Upper Burma Hills', *J.B.N.H.S.*, vol. xxxiv, No. 2, p. 343.
[2] Op. cit., p. 221.
[3] *Fauna of British India*, vol. v, p. 366.
[4] Op. cit., *J.B.N.H.S.*, vol. xxviii, 1, p. 5.
[5] Op. cit., *J.B.N.H.S.*, vol. xxvii, 4, p. 654.

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THE VERNAY SCIENTIFIC SURVEY OF THE EASTERN GHATS (ORNITHOLOGICAL SECTION).

BY

HUGH WHISTLER, M.B.O.U., assisted by N. B. KINNEAR, M.B.O.U.

PART VII.

(*Continued from page* 844 *of volume* XXXVI).

Anthus trivialis trivialis Linnaeus.

Anthus trivialis Linn., Syst. Nat., ed. 10, vol. i (1758), p. 166—Sweden.

Specimens collected:—1098-1100 ♀♀♀ 13-12-29; 1113-1114 ♀♂ 1115 ♀ 1117 ♂ 15-12-29, 1128 [♂?], 16-12-29, Cumbum Valley; 1451-1454 ♀♀♂♂ 1-3-30 Sankrametta 3,500 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
4 ♂	14-15	83.5-88	59.5-65.5	20-21.5 mm.
7 ♀	13.5-15	83-89	59-65	19-21.5 mm.

The Tree Pipit was met by the Survey in large flocks in February at Anantagiri and Sankrametta. By the end of March their numbers were greatly diminished and in April they had left the district (La Personne). In this area they had been previously recorded by Ball at Jeypore (S.F., v, 417).

Mr. La Personne also informs me that in the Godaveri Delta Tree Pipits were seen in large flocks in ploughed fields and also frequently met with in wooded areas though no specimens were actually preserved. The series from the Cumbum Valley in December complete the records for this side of the Presidency.

In the *Old Fauna* Oates was unable to record this species south of Belgaum, but its range on the western side of India certainly extends to the Nilgiris as Col. H. R. Baker's collection contains two specimens shot at 6,000 ft. on 26 January 1902. The *New Fauna* states that it reaches Travancore but I have seen no evidence to that effect.

Anthus trivialis sibirica Sushkin, to which we should expect our Southern and East Indian birds to belong, does not appear to me to be a race worth recognition. It is evidently the intermediate between the typical race and *A. t. haringtoni* and anyone who has had practical experience of the difficulty of distinguishing those two forms out of their breeding areas will agree that there is nothing to be gained by naming the intermediate.

Anthus hodgsoni hodgsoni Richmond.

Anthus hodgsoni Richmond, Blackwelder's Researches in China, pt. ii (1907), p. 493—India.

Specimens collected:—1251 ♀ 14-1-30 Godavery Delta.

Measurements:—

Bill.	Wing.	Tail.	Tarsus.
14	81	59.5	20 mm.

Hodgson's Tree-Pipit is a very common winter visitor to the hills of the western side of the Presidency where it is usually met with in small flocks. In the Wynaad, the Nilgiris, the lower hill country of the Nelliampathies and in the Palnis it seems to be very generally distributed. In Travancore according to Ferguson it is only found at high elevations in the hills and never in the plains. He obtained it both on the High Range and at Chimunji at 4,000 ft. in South Travancore. The numerous specimens which I have examined from this side show that it occurs at least from 13 October to 19 April.

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On the eastern side of the Presidency the above Survey specimen and Ball's statement (S.F., v, 417) that it has been met at Jeypore furnish the only records traced.

Now it is evident at the first glance that the very uniform lightly streaked birds found in South-West India are not the same as the heavily streaked birds which breed at high altitudes in the Western Himalayas and winter in the lower ranges and foothills of that area. As this fact does not agree with Mr. Stuart Baker's treatment of the species in the *New Fauna* (vol. iii, pp. 281-283) I have been compelled to examine the races *de novo*. Mr. Stuart Baker recognises three races; the typical race of which he gives the type locality (wrongly) as Nepal and to which he attributes all specimens found in the Himalayas and India proper; *A. h. yunnanensis* (Mengtz, Yunnan) and *A. h. berezowskii* (S. W. Kansu) which occur in Burma, the former said to be much darker than the typical race and the latter intermediate between the other two. Neither of these races can I separate however from the Himalayan breeding bird. As regards the first the describers Messrs. Uchida and Kuroda, Annot. Zool. Japan, ix (1916), p. 134, merely claimed that it seems 'to be constantly characterised by having the bill distinctly shorter than in the typical species', a point which my examination does not bear out. *A. h. berezowskii* was apparently only named by Zarudny at third hand, Orn. Monatsb., vol. xvii (1909), p. 43; he seems never to have seen the specimens he was naming but merely gave a name to some remarks by Berezowski and Bianchi on specimens from Potanin's expedition. The Kansu specimens I have seen agree with Himalayan birds. It must be remembered that great numbers of this Pipit sweep down across Southern Asia in autumn and that it is necessary to distinguish between those migrants and local breeding birds. Both these races, even if good ones and it will be noted that Dr. C. B. Ticehurst (J.B.N.H.S., xxxii, p. 351) has independently thrown doubt on them, are of the same dark heavily streaked type as the Himalayan bird. I find however that Siberian birds are definitely separable. Compared with the Himalayan breeding race the upper parts are greyer and more uniform, the streaks on the hind neck, mantle and back being narrower and much less distinct so that in some specimens the upper parts are almost immaculate or appear merely mottled rather than streaked. The black streaking on the lower parts is both narrower and less numerous, virtually dying out on the flanks and abdomen which also I think do not attain the rich rufous brown wash of Himalyan birds. The under-tail-coverts are white, not warm buffish white as is usual in the latter.

These Siberian birds evidently account for our lightly marked birds in South-Western India and indeed the greater part of India and it is therefore necessary to establish their name; and that must depend on whether *Anthus hodgsoni* Richmond in Blackwelder's Researches in China, pt. ii (1907), p. 493 refers to the heavily or lightly streaked birds. In Jerdon's Birds of India, vol. ii, p. 228 *Pipastes agilis* Sykes is used as the name for this species. In the Appendix, vol. iii, p. 873 Jerdon states that Sykes' *agilis* is the true *arboreus* and that 'the common Indian race therefore will bear Hodgson's name *maculatus*'. This name was however not really available, as it was a *nomen nudum* and had already been made a synonym of *trivialis* and it was in place of Jerdon's name *maculatus*, not Hodgson's *maculatus*, that Richmond gave his new name, which takes the description and type locality of Jerdon's vol. ii, p. 228. The description may perhaps be considered as a composite in which the lightly streaked (Siberian) form is considered the winter plumage and the heavily streaked (Himalayan) form is considered the summer plumage. The type locality is 'all India', the only specific locality mentioned lower down being 'Calcutta and elsewhere in Bengal'. As the lightly streaked Siberian bird is the form found throughout the greater part of India and as the only Bengal specimens I have seen belong to it we shall be safe in attributing Richmond's name to this race.

There is no doubt that Hodgson's *Anthus maculatus* was the heavily streaked Himalayan bird. I have examined his drawings and under the name *maculatus* are figured two very heavily streaked specimens, whilst the plain-backed bird is separately figured as *Anthus brevirostris* Mihi, a name which also is unusable. Both forms are represented in his specimens in the British Museum. Jerdon's *Anthus maculatus*, however much it derived in the

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Author's mind from Hodgson, has nomenclatorially to be treated as a separate conception.

The Himalayan breeding form will then take, under my views as expressed above, the next available name namely *Anthus hodgsoni berezowskii* Zarudny (loc. cit.).

The single specimen obtained by the Survey is somewhat intermediate.

[Since the above was written part ii of the Supplement to Die Vögel der paläarktischen Fauna has appeared and Dr. Hartert and Dr. Steinbacher have described the lightly streaked form as *Anthus hodgsoni inopinatus* (Sakhalin). If my view as detailed above is correct then *inopinatus* will become a synonym of *hodgsoni*. See also Ibis 1933, p. 571.]

Anthus nilghiriensis Sharpe.

Anthus nighiriensis Sharpe, Cat. Birds Brit. Mus., vol. x (1885), p. 550—Nilgiris.

The Nilgiri Pipit is peculiar to the Madras Presidency where it is resident and only known to occur at high elevations in the hill ranges of the South-West. On the Nilgiris it is restricted to the pleateau where its haunts are the open downs covered with short grass and it does not occur below about 6,000 ft. (William Davison) or 5,000 ft. (Betts). Within these limits it is common. It is similarly common at 7,000 ft., and probably lower, on the grassy downs of the Palnis and it is also fairly common on the open grass lands of the High Range in Travancore. Ferguson also records (J.B.N.H.S., xii, 203) that he had a specimen from Ponmudi in South Travancore.

The breeding season according to Terry, Davison and Betham is in April and May.

Anthus similis similis Jerdon.

Anthus similis Jerdon, Madras Jour. Lit. Sci., vol. xi (1840), p. 35—South India = Jalna.

The Rufous Rock-Pipit is a somewhat scarce resident on the Nilgiris where it is confined to open slopes and high plateaux and escapes observation by its shyness. Hume (S.F., i, 203) says that it also occurs in the Palnis and Anamalais and in Travancore Ferguson obtained a single specimen at Ponmudi in August 1900 at 3,500 ft.

Eggs were taken in the Nilgiris by Miss Cockburn in March and May.

There is a certain amount of difficulty about the correct name of the Rufous Rock-Pipit and this has not been cleared up by the very confused discussion of it in the *New Fauna*, vol. iii, p. 284.

The first name to be given to any member of this group of subspecies in India was *Anthus similis* Jerdon, Madras Jour. Lit. Sci., vol. xi (1840), p. 35.

The description accurately indicated this species but was not sufficiently detailed to show which of the three closely allied Indian subspecies was meant. The type locality was not clearly indicated but he said 'I only once observed this large Titlark in an open stony plain, there were a pair of them together and I noticed that their flight was performed somewhat differently to that of the Titlarks in general, there being a more frequent flapping of the wings'.

The type locality is however clearly settled by Jerdon's later statement in his Illustrations of Indian Ornithology, pl. xlv (1847), where he says 'my first specimens were procured at Jalna in the neighbourhood of low hills on a bare plain'. The fact that he then figured the dark Nilgiri bird and remarked 'I have since, on several occasions, seen it on the Segoor Pass of the Neelgherries among rocky ground about 4,000 ft. high' no more makes the type locality the Nilgiris than his idea that it also probably occurred in the Himalayas could transfer the type locality northwards.

The actual type specimens are not known to exist. We have, therefore, to decide whether the bird that Jerdon met at Jalna is more likely to have belonged to the Himalayan, Baluchistan or Nilgiri races. Both the northern forms wander southwards in winter as far as the Bombay Presidency, so either might easily occur at Jalna. At the same time the Nilgiri bird might easily be found as far north. There is a single male specimen (not specimens as Mr. Stuart Baker says) in the British Museum collected by Fairbank

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on 30-12-74 on the Imampur Ghat near Ahmednagar (S.F., iv, 260), and Captain Gosse obtained a female with 3 eggs on the Two Sister's 2,300 ft. near Poona on 11th August. This bird we have carefully examined and can only attribute to the Nilgiri form. As Jerdon's pair were evidently displaying the obvious inference would seem to be that *Anthus similis* of Jalna must be the Southern form. Against that inference however we must set the fact that Jerdon later in 1863 (Birds of India, vol. ii, p. 236) when he had recognised that the Himalayan and Nilgiri birds were distinct expressly attributed his original Jalna specimens to the Himalayan form, though there is nothing to show whether they were still available for comparison. Identification of these races by memory would not be trustworthy.

In face of these difficulties it would have been better to reject the name *Anthus similis* Jerdon as unrecognisable had only a subspecific name been at issue. The issue is however wider. The specific name for this group of pipits, which includes various African members, is given in the *New Fauna* as *Anthus sordidus* Rüppel, Neue Wirb., Aves (1835), p. 103—Abyssinia. This cannot, however, be used since, as Friedmann has pointed out (Proc. Biol. Soc. Wash. 1932, p. 164) that name is preoccupied by *Anthus sordidus* Lesson. Chili. Voy. Coquelle Zool., i (2) 1831, p. 644 = *Lessonia rufa rufa* (Gmelin). Friedmann suggests that *Anthus nicholsoni* Sharpe, Layards Birds, S. Africa (1844), p. 536, is the next oldest name but he has apparently overlooked both this *Anthus similis* Jerdon (1840) and also *Anthus jerdoni* Finsch. 1870, Tr. Z. S., p. 241. *Anthus similis* Jerdon must clearly be used for the specific name of the group even if it is not clearly recognisable subspecifically. Under the circumstances I propose to restrict the name to the South Indian breeding bird and use *Anthus cockburniæ* Oates, *Fauna. Brit. Ind.*, Birds, vol. ii (1890), p. 305—Nilgiris, Coonoor, as a synonym.

Anthus richardi Vieillot.

Anthus richardi Vieillot, Nouv. Dict. d'Hist. Nat. nouv., ed., 1818, vol. xxvi, p. 491—France.

Specimen collected:—1279 ♀ 20-1-30 Godaveri Delta.

Measurements:—

Bill.	Wing.	Tail.	Tarsus.
16	90.5	75	30 mm.

One cannot consider as very satisfactory the account of Richard's Pipit in the *New Fauna* (iii, p. 289):—'common all down the east coast to Ceylon, west it has been found as far as the Sutlej Valley, but has not been recorded from the Bombay Presidency or further South on the West Coast'.

Richard's Pipit is a well known and common winter visitor to the eastern part of the Indian Empire from Assam and lower Bengal to Tenasserim. It also is common in the Andamans and in Ceylon (which it may perhaps reach via the Andamans) it is found from October until May. I can find no authority at all for the statement that it is common all down the east coast of India. There are indeed only three records for that side south of Lower Bengal, viz., Ball's inclusion of it in his list of Nowaghar and Karial birds 1876-1877 (S.F., vii, 220), the above Survey specimen, and the fact that a specimen obtained in Chingleput is said to be in the Madras Museum.

In the Nepal Valley Scully found it a rather scarce winter visitor (S.F., viii, 316) and there are one or two records from Bihar and the United Provinces. The statement that it occurs in the Sutlej Valley is due to Stoliczka but I am by no means certain that that record was not due to confusion with *A. s. jerdoni*. Be that as it may, and there are no records for the Punjab, Sind and Rajputana, Richard's Pipit has been recorded far further west at Kohat (Whitehead, Ibis 1909, p. 243) and two specimens collected there on 4-1-06 and 14-2-08 are in the British Museum. Captain Whitehead later obtained it at Sehore on 22 May (J.B.N.H.S., xxii, p. 156—specimen in the British Museum), though the record for Mhow (J.B.N.H.S., xxxv, 393) is based on a misidentification of *A. r. thermophilus*.

In the Bombay Presidency it has been recorded by James Davidson—two specimens obtained at Honawar in January 1890 (J.B.N.H.S., xi, 674). Further south on the west there are specimens in the British Museum from Coorg

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(Tweedale Coll.), Kotagiri (♀ 17-10-70 Cockburn), Slope of the Nilgiris (♂ March 1877 Hume Coll.), and two Anjango specimens in the Hume Collection. Colonel H. R. Baker also obtained a male at Cannanore on 24-2-10 and this specimen is now in my collection.

This fine Pipit is a confirmed wanderer. It has been recorded over 80 times in the British Isles and it may be expected to occur casually in any part of India though its true winter quarters lie further to the east.

I have left the name binomial as I have considerable doubts whether Richard's Pipit is to be considered as having any races. *Anthus thermophilus* Jerdon (=*striolatus* auct.) is now said to be a race of *campestris* (vide Kozlova, Ibis 1933, p. 83). *Anthus rufulus* and allied forms in Asia and Africa are best treated as a separate group. I am unable to recognise *Anthus richardi centralasiae* Kistiakowsky, Works of the Ukraine Academy of Sciences, vol. vi, no. 3 (1928), p. 551—Nanshan, for Madame Koslov (*loc. cit.*) has shown that the supposed colour differences do not hold good and whilst she is inclined to agree to a slight difference in size my own researches show that that is also non-existent.

Anthus campestris thermophilus[1] Jerdon.

Corydalla thermophilus Jerdon, Birds of India, vol. ii (1863), p. 233 (ex. Hodgson *nom. nud.* quoted as synonym of *Corydalla striolata*)—Nepal.

Mr. Stuart Baker throws considerable doubt on the validity of Blyth's Pipit as a good form (*New Fauna*, vol. iii, p. 289) and says that the only difference between it and Richard's Pipit consists in the length of the hind claw. The matter cannot be satisfactorily cleared up until a series of Blyth's Pipit is available from its breeding quarters but in the meantime I personally find no difficulty in accepting the distinction in size made in the *Old. Fauna* (vol. ii, 308) which is most easily recognised from the tarsus. Witherby gives the length of the tarsus in the male Richard's Pipit as 31-32 mm. (Prac. Handbook, i, 173) and I find that 12 males from Central Asia, taken at random, give a tarsus length of 29.5-33 mm. I have not been able to examine such a satisfactory series of females but in that sex also the tarsus is evidently as a rule 30 mm. or longer.

Fifteen supposed *thermophilus* of both sexes, on the other hand, yield a tarsial length of 25-28.5 mm. and if this difference can in due course be shown to be correlated with a distinct breeding range it must certainly be recognised. According to Stegman and Madame Koslov who have studied the various breeding ranges *thermophilus* is to be considered a race of *campestris* and not of *richardi*.

Accepting *thermophilus* as a good form, therefore, I find the following records for the Presidency. Jerdon (Birds of India, ii, 234) says that he procured it in the Nellore district, generally near low bushy hills. Ferguson says that it is a winter visitor to Travancore, found in fairly large numbers in February and March in the dry paddy fields after the crops have been cut. A male collected at Coimbatore on 9-10-68 by A. G. R. Carter, a female from Kotaghery collected by Miss Cockburn on 17-10-70 and a third bird from the slopes of the Nilgiris, March 1877 are in the Hume Collection in the British Museum.

Blyth's Pipit is not nearly so widely distributed in India as Mr. Stuart Baker implies. There is no record for the N.-W.F.P., Baluchistan, Punjab, Sind or Rajputana.

Anthus rufulus rufulus Vieillot.

Anthus rufulus Vieillot, Nouv. Dict. d'Hist. Nat., nouv. ed., vol. xxxvi. (1818), p. 494—Bengal.

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[1] This name cannot really be used as it had already been quoted as a synonym of *A. rufescens* of Temminck. No other name appears to be available and I hesitate to give one in view of my doubts as to the validity of this form.

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Specimens collected:—230-238 ♂♀♀♀♂♂♂♀♀ 16-5-29 Shevaroy Hills 5,400 ft.; 680 sex? 12-8-29 Palkonda Hills 500 ft.; 1119 ♂ 16-12-29 Cumbum Valley; 1192 ♂ 1195 ♀ 6-1-30, 1199 ♂ 7-1-30, 1211-2 ♂♂ 1215 ♀ 9-1-30, 1224 ♂ 11-1-30, 1238 ♀ 13-1-30, 1261 ♀ 16-1-30, 1268-1270 ♀♂♀ 1234 ♂ 19-1-30, 1277 ♂ 20-1-30, 1296 ♀ 23-1-30, 1306 ♂ 1308 ♀ 25-1-30, 1312-3 ♂♀ 26-1-30 Godaveri Delta; 1689 ♀ 16-4-30, 1706 [♂] 19-4-30 Jeypore Agency 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
15 ♂	15-17.5	79-85	54-62	24-27 mm
15 ♀	15-16.5	76.5-81	53-56.5	25-26 mm.

Dewar states that the Indian Pipit does not seem to be very common at Madras. With that exception the whole of the records for the Eastern side of the Presidency are supplied by the above series collected by the Survey. La Personne remarks that they were common on the grassy hill tops of the Shevaroy Peak 5,400 ft. where they were breeding under the low scrub that clothed the summit. They were also found breeding commonly in the Godavery Delta.

On the western side there is much more information about it. In Coorg it is a common resident, breeding wherever there is open grassland (Betts). In the Brahmagherries, the Wynaad and the Nilgiris it is very common (William Davison). In the last named Mr. Betts informs me that it replaces the Nilgiri Pipit on the lower hillsides, wherever they are sufficiently open and grassy. Kinloch found it on the Lily Downs of the Nelliampathies about 4,700 ft. Fairbank obtained it at the base of the Palnis and at 4,000 ft. in these hills. In Travancore (Ferguson) it is resident and very numerous in the low country in the dried paddyfields and also on open grassy ridges in the hills at all elevations.

Nothing appears to have been recorded about the breeding season in the Presidency. From the careful notes about the state of the organs on the labels of the fine Survey series it is evident that in the Godavery Delta the birds were laying about the middle of January and in the Shevaroy Hills they were breeding in May.

Ticehurst has already pointed out (J.B.N.H.S., xxxii, p. 352) that the *New Fauna* is wrong in extending the typical race of this Pipit to Ceylon and we agree with him that the island birds must be attributed to the race *malayensis*. We are not yet satisfied as to the subspecific identity of the birds of the western side of the Presidency but hope to return to this point in the report on the Travancore Survey.

Alauda gulgula australis Brooks.

Alauda australis Brooks, S.F., i (1873), p. 486—Ootacamund.

Specimens collected:—1190 ♂ 1193 ♂ 1197 ♀ 6-1-30, 1198 ♂ 1200 ♂ 1202 ♂ 7-1-30, 1213-4 ♂♂ 9-1-30, 1223 ♂ 1225 ♂ 1227-8 ♀♂ 11-1-30, 1236 ♂ 1239 ♀ 1240 ♂ 1242 ♂ 1244 ♂ 13-1-30, 1257-8 ♂♂ 1260 ♂ 16-1-30, 1264 ♂ 1267 ♂ 1272 ♂ 19-1-30, 1280-1 ♂♂ 20-1-30, 1307 ♂ 25-1-30, 1311 ♂ 26-1-30 Godaveri Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
24 ♂	14-16 (once 13)	87-93	49-56	22.5-26 (once 21.5) mm.
3 ♀	13-14.5	84.5-85.5	48.5-50	22.5-24.5 mm.

From the organs of the above series it was evident that they were breeding, and Mr. La Personne moreover remarks that they were breeding freely on the sandbanks opposite Dowlaisheram, the nests being built under tufts of grass about 3 feet from water, usually on damp soil.

No other skylarks were obtained by the Survey and on the eastern side of the Presidency the only other record is Dewar's statement that the skylark is common at Madras.

On the west the Indian Skylark is far better known. Although less abundant in the Wynaad it is according to William Davison and others very common all over the grassy downs of the Nilgiris. Here, Mr. Betts informs

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me, it breeds in April and May and again after the monsoon, in September and October. Terry found nests at Pulungi and Pittur in the Palnis in April and considered it common on the tops of bare rocky hills. In Travancore Ferguson says that it is common on the High Range and he also met with it in the plains.

It is with great hesitation that I have referred the above series of skylarks to *A. g. australis*. They are certainly smaller than the few Nilgiri specimens which I have been able to examine, but my series from the latter range is not large enough to settle this point satisfactorily. I hope to obtain more material in time to return to the question in connection with the Travancore Survey.

Calandrella brachydactyla dukhunensis (Sykes).

Alauda dukhunensis Sykes, P.Z.S. 1832 (July 31), p. 93—Dukhun.

Specimens collected:—1271 ♀ 19-1-30, 1294 ♂ 23-1-30, 1316 ♂ 26-1-30 Godaveri Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	13-13.5	100-101	59.5-60	20.5-21.5 mm.
♀	13	92	51	20 mm.

These three specimens provide the only records of the Rufous Short-toed Lark within the Presidency. This race of Short-toed Lark appears to be confined in winter in India to an area lying east of a line through Etawah, Mhow and Khandesh and north of another line from North Kanara to the Godavery Delta. The implication in the *New Fauna* (vol. iii, p. 326) that it occurs in North-West India is not supported by any evidence except a specimen in the Hume Collection obtained by Dr. Day at Karachi on 21-10-71 of which the identification is doubtful and not accepted by Ticehurst (Birds of Sind, Ibis and J.B.N.H.S., xxxii, 353).

[Mirafra javanica cantillans Blyth.

Mirafra cantillans Blyth, J.A.S.B., vol. xiii (after December 1844), p. 960 ex J.A.S.B., vol. xii (1843), p. 181 *nom nud;* ex Jerdon, MS.—Bengal.

The status of the Singing Bush-Lark in the Presidency is not very clear. Jerdon informs us that it is most abundant in the Carnatic and the Northern Circars and the *New Fauna* states that it is found down to Travancore on the west, but no corroboration of Jerdon's statement was found by the Survey and the bird does not occur in Ferguson's Travancore list. Nor have I traced any other record for the Presidency].

Mirafra affinis Jerdon.

Mirafra affinis Jerdon, Madr. Jour. Lit. Sci., xiii, pt. 2 (1844-1845), p. 136—Goomsoor in Ganjam.

Specimens collected:—7 ♂ 9-4-29, 9 ♀ 18-4-29, 43 ♂ 13-4-29, 61 ♀ 16-4-29, 75 ♂ 17-4-29, 123 ♀ 24-4-29, 126 ♂ 25-4-29 Kurumbapatti; 298 ♂ 31-5-29, 309 ♀ 2-6-29, 376-377 ♂♂ 11-6-29, 386 ♀ 12-6-29, 395 ♀ 13-6-29, 418 ♂ 15-6-29 Chitteri range 2,000-3,000 ft.; 443-444 ♀♂ 18-6-29 Harur 1,000 ft.; 454 ♂ 20-6-29, 465 sex? 23-6-29 Tirthamalai 1,000 ft.; 484 ♀ 2-7-29 Trichinopoly; 503 ♂ 509-510 ♂♀ 4-7-29 Kalai; 534-535 ♂♂ 8-7-29 Vyampatti Trichinopoly; 550 ♂ 18-7-29, 577 ♀ 22-7-29, 588 ♂ 23-7-29 Gingee; 746 ♂ 24-8-29, 751 ♀ 752 ♂ juv. 758 ♀ 759 ♂ 26-8-29, 760 ♂ juv. 761 ♂ 27-8-29 Palkonda Hills 5,000 ft.; 809 ♂ 810 ♂ 12-9-29, 820 ♂ 822 sex? 17-9-29, 835 ♂ 838 ♂ 20-9-29 Kodur; 867 ♂ 870 ♀ 3-10-29, 914 ♂ 13-10-29 Seshachalam Hills 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
25 ♂	14.5-17.5	77-88	43-50	23.5-27 mm.
13 ♀	13-17	75-82	38.5-45	24.5-28 mm.

The Madras Bush-Lark according to Jerdon occurs as far north as Gumsoor

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in Ganjam and Midnapur and the former is the type locality. The only specimen that I have been able to examine from as far north is one collected by Colonel Walton at Samol, Jalchar, Orissa (Bombay Society's Museum) and there appears to be no other record until the Godavery valley is reached, a specimen from near Ellore being in the Hume Collection. The fine series collected by the Survey proves that this lark is very generally distributed both in the plains and in the hills up to 5,000 ft. from Kodur and the Seschachalam Hills down to the Cauvery River, and doubtless on to Cape Comorin and the bases of the Travancore ranges. On the west it is less well known. A specimen was collected by Col. H. R. Baker at Cannanore on 29 May 1910. There are two specimens from Coorg in the Tweedale Collection. William Davison tells us that it occurs round the base of the Nilgiris but the only specimens I have seen are a female collected by Col. Sparrow at Goodalore on 1-4-1914 and a male in the Hume Collection collected by Dr. Day on 1-1-1873 at Coonoor. In Travancore, according to Ferguson, it is common in the plains, where it occurs in the grasslands, sometimes in flocks and sometimes solitary.

The breeding season has not been accurately recorded. The organs of the Survey series suggest that it extends from about April to July on the eastern side and Ferguson took a single egg in Travancore on 26 April. Young birds obtained by the Survey in August resemble the adults. The feathers of the upper parts have pale fringes producing the scale marking characteristic of most juvenile alaudidae; the pale chestnut edges to the wing coverts, and wing and tail quills are proportionately broader than in the adult and on the primaries extend also round their tips.

The Madras Bush-Lark can certainly not be considered a race of *Mirafra assamica*. The change in colour is too abrupt and striking and hardly likely to be correlated with the reappearance of the dark *affinis*-like form *microptera* in Burma. It must either be treated as a separate species or as a race of *Mirafra erythroptera* the Red-winged Bush-Lark. From this it differs:—

(1) Size: larger with a proportionately larger bill and shorter tail. 18 males of *M. e. erythroptera* measure bill 13-15, wing 76-84, tail 47-55 mm.

(2) The upper parts are darker, with the dark centres of the feathers proportionately larger; lower parts darker, more buff, less creamy.

(3) The chestnut on both webs of the primaries is less extensive, being divided along the shaft by a long dark distal wedge, whereas in *erythroptera* the whole of the basal two-thirds of the feather is chestnut, the shaft alone being dark brown.

(4) The inner secondaries are dark brown merely edged with chestnut, whereas in *erythroptera* they are usually completely chestnut.

These differences are merely those of degree such as one finds amongst subspecies and intermediate specimens are certainly found. Moreover the ranges of the two forms are largely complementary in the Peninsula. I have plotted out the records of both forms on a map and find they are only said to coincide in certain areas near the junction of the two distributions. These areas are Chota Nagpur (Singhbhum: Mannbhum), Hyderabad State, Belgaum and N. Kanara, Manzeerabad, Mysore and Cannanore. Some of these coincidences can I think be dismissed as erroneous, based on old and faulty identifications, and the only one substantiated by specimens is that of Hyderabad. In Hyderabad both Colonel Sparrow and Mr. Salim Ali undoubtedly obtained both forms in the south-east of the State as has been narrated in detail in the Hyderabad Survey. I expect that further observation in this area will show that either both forms occur in different terrain, as Jerdon expressly stated to be the case when he met *Mirafra erythroptera* 'once only in the Carnatic at the foot of the Eastern Ghats inland from Nellore' (B. of I., ii, 419) or that there is some seasonal wandering.

[Except for the above statement by Jerdon there is no reason to admit *Mirafra erythroptera erythroptera* to the Presidency list. Colonel H. R. Baker states (Birds of S. India, p. 120) that he obtained it and its nest during the monsoon at Cannanore. This specimen duly labelled *M. erythroptera* 29 May Cannanore is still in his collection, which I purchased about 1925-1926, but it is a specimen of *M. affinis*.]

Alauda coromandeliana Pucheran ex Cuvier MSS., Revue Mag. Zool. 1854, p. 63, based on a specimen obtained by Leschenault in 1819 at Pondicherry is a synonym for this race.

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Galerida malabarica Scopoli.

Galerida malabarica Scopoli, Del. Flor. et Faun., Insubr., vol. ii (1786), p. 94—Malabar Coast.

Not obtained by the Survey. The Malabar Crested Lark is confined to the western side of the Presidency.

A female collected by Dr. Day at Mangalore on 23-4-1873 is in the British Museum and another female collected by Col. H. R. Baker on 11-8-1910 at Cannanore is in my own collection. Two males collected by William Davison near Manantoddy, Wynaad, on the 5th and 12th April 1881 are also in the British Museum. Mr. Betts informs me that it is common in Coorg wherever there is open country, gathering in flocks out of the breeding season.

In the Nilgiris, according to Davison, it replaces *Galerida deva*, which is the lark on the low country on the Mysore border. It is not uncommon on the plateau, frequenting the grassy hills in pairs and small parties, and in the main it is certainly resident though Davison relates how on 23 May he met a flock of some 30 birds, unsettled as if on passage, a few miles from Gundalopet in Mysore.

In Travancore Ferguson says that it is only found on the High Range at 6,000 ft., where it is fairly abundant and goes about usually in small flocks.

In the Nilgiris according to Miss Cockburn the Malabar Crested Lark breeds twice a year in March and April and again in August and September. Colonel Sparrow informs me that he took 2 nests with eggs in the Cardamum Hills in March.

It seems hard to believe that Sykes' Crested Lark *Galerida deva* (Sykes) should not be treated as a race of this species. The differences of colour and size in the two forms might easily be merely subspecific and in the main the ranges of the two forms are complementary, *malabarica* being confined to a narrow strip along the west coast from Ahmedabad to Travancore whilst *deva* is widely spread in the centre of the Peninsula. There seems however to be no doubt that both forms occur in Ahmedabad, Nassick, Belgaum and S. Mysore. Careful field work in the future may show that these coincidences are compatible with two subspecies, but in the meantime it is safer to treat both forms as species.

Ammomanes phoenicura phoenicura (Franklin).

Mirafra phoenicura Franklin, P.Z.S. 1830-1831 (25 October 1831), p. 119—Between Calcutta and Benares and in the Vindhyan Hills between the latter place and Gurra Mundela.

Specimens collected:—530-531 ♂ juv., o? juv. 7-29 Kalai, Trichinopoly; 930 ♀ 18-10-29 Seschachalam Hills 2,000 ft.; 1043 ♂ 1046-7 ♂♂ 5-12-29, 1048-1051 ♂♂♀♂ 6-12-29, 1053 ♂ 7-12-29, 1087 ♀ 1090 ♂ 11-12-29, 1103 ♂ 13-12-29, 1131 ♀ 17-12-29, 1137 ♂ 18-12-29, 1157 ♀ 22-12-29, 1181-2 ♂♂ 27-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
12 ♂	15.5-17.5	104-110	58-63	21.5-23 mm.
5 ♀	15-16	99-103	52-59.5	20.5-23 mm.

The Rufous-tailed Finch-Lark is evidently confined to the drier parts of the Presidency as a resident species. In addition to the three localities in which it was obtained by the Survey in the Cumbum Valley, the Seschachalam Hills and Trichinopoly I can only trace a single record for our area, namely a female in the Hume collection obtained by A. G. R. Theobald at Coimbatore on 10 October 1868.

The organs of the Cumbum Valley series suggest that they would have bred in the early part of the year.

Eremopterix grisea grisea (Scopoli).

Alauda grisea Scopoli, Del. Flor. et Faun., Insubr., vol. ii (1786), p. 95—Ginge, South Arcot District, India.

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Specimens collected:—483, 485 ♂♀ 2-7-29 Trichinopoly; 496 ♀ 498 ♂ 3-7-29, 500 ♂ 4-7-29 Kalai; 592-3 ♂♂ 24-7-29 Gingee; 800 ♀ 10-9-29, 821 ♂ 17-9-29 Kodur; 1047A ♂ 6-12-29, 1052 ♂ 1054-1057 ♂♂♂♂ 7-12-29, 1061-2 ♂♀ 1064-5 ♂♀ 8-12-29, 1070 ♂ 1072 ♀ 9-12-29, 1092 ♀ 12-12-29, 1104 ♂ 13-12-29, 1116 ♀ 15-12-29, 1163 ♀ 1168 ♂ 23-12-29, 1194 ♀ 6-1-30, 1201 ♀ 7-1-30, 1273 ♀ 19-1-30, 1276 ♀ 20-1-30 Cumbum Valley; 1191 ♂ 6-1-30, 1226 ♂ 11-1-30, 1237 ♂ 13-1-30, 1259 ♂ 16-1-30, 1265 ♂ 19-1-30, 1319 ♂ 29-1-30 Godavery Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
24 ♂	10.5-13	74-78	39.5-46	14-16 mm.
13 ♀	11-12.5	71.5-77.5	37-42.5	14.5-16.5 mm.

There is no record of the Ashy-crowned Finch-Lark in the Presidency north of the Godaveri River but southwards it is evidently so common and so generally distributed that there is no need to cite the various records. It is however confined to the plains and does not ascend any of the hill ranges. It occurs on Rameswaram Island.

The few breeding records suggest that individual birds may nest at any time of the year. Theobald found a nest with 3 eggs at Salem on 21 August (N. & E., ed. 2, vol. ii, p. 245); Terry found a nest on the roof of a godown at Bellary in December (*loc. cit.*, p. 246). The organs of the Survey series suggest that some birds were breeding about Trichinopoly in July and in the Cumbum Valley in December and January. Captain R. S. P. Bates informs me that it breeds from February onwards until the rains and gives me an interesting account of how in June at St. Thomas' Mount he found 4 nests within 130 yards, of which two were only four paces apart.

Owing to the courtesy of the Director of the Colombo Museum I have been able to examine a fine series of 12 males and 5 females of this lark from Ceylon. These undoubtedly differ from the typical form in the slightly longer and much heavier bill which approximates to that of *Eremopteryx frontalis* (*melanauchen* Old Fauna). As a large bill is an oft-recurring characteristic of the insular races in Ceylon, I think it should be emphasised again in this case by the bestowal of a name and I therefore propose the name

EREMOPTERIX GRISEA CEYLONENSIS subs. nov.

Type:—♂ ad. 11 January 1922, collected by G. Brown, 8 miles north of Paletupani East Coast, Ceylon (H. Whistler Coll.).

(To be continued).

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SOME NOTES ON BISON (*BIBOS GAURUS*) IN BURMA

BY

W. S. Thom, I.P. (*Retd.*).

(*With two plates*).

No one who has followed and shot a solitary bull Gaur, or Bison, as he is usually called, can fail to be impressed by his immense size, noble appearance, and magnificence of the trophy obtained. Neither can he deny that the sportsman in Burma will, on occasions, in encounters with these animals, obtain all the thrills and excitement he can possibly desire, and, had I not said in a previous article in the *Journal* that I considered elephant shooting the grandest of all sports, I might, on reflection, have reversed that decision in favour of bison shooting.

My own experience over a course of 45 years of the jungles of Burma has shown me that no more dangerous animal is to be met with in the jungle in any part of the world, except, perhaps, a wounded tiger, boar, or lion, than an old wounded bull bison standing between 19 and 21 hands at the shoulder. Bison are indeed the largest of all the oxen in the world and stand, if I mistake not, higher than the biggest cart horse that was ever foaled. Woe betide the sportsman who, when following up a wounded bull bison, especially in the dense forests of Burma, fails to stop him in his charge, when, with head down he comes tearing along with great strides bent on demolishing everything in his path. To say that a Tsaine or Banting (*Bibos sondaicus*) is a more dangerous animal to tackle than a bison when wounded or otherwise, is quite incorrect. A bull Tsaine is certainly more active, and more alert, and has better hearing and sight than a bull bison but he is not nearly so dangerous. Bison as a rule stand higher in Burma than they do in any other part of the world, and also have finer heads than are obtainable elsewhere. The true bison is the American animal, so to speak of the gaur as a bison is a misnomer although for the purposes of this article I shall refer to it as a bison. The sportsman and his hunters will require not only to exercise every atom of the skill and woodcraft possessed by them to avoid fatal mishaps occurring when tracking down old solitary bull bison, but a good rifle is also a *sine qua non*.

Nothing smaller than a 577, 500, or 470 bore cordite rifle should, in my opinion, be used on these big animals. In fact I would recommend the use of one or other of these rifles on all large and dangerous game such as elephant, bison, tiger, rhinoceros, buffalo, and tsaine, when you have to meet them on an equal footing, that is to say on foot and not when you are up a tree in a machan, or on the back of an elephant where you are in a comparatively safe position, and can afford to take risks and experiment with rifles of smaller calibres than those referred to above. It is all very well for the experienced sportsman who

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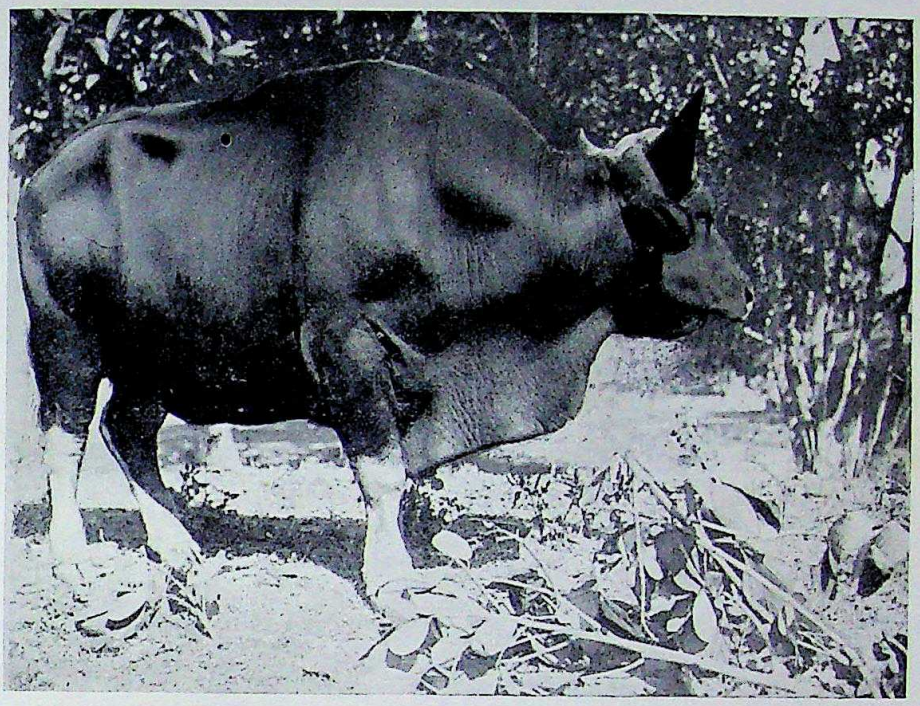
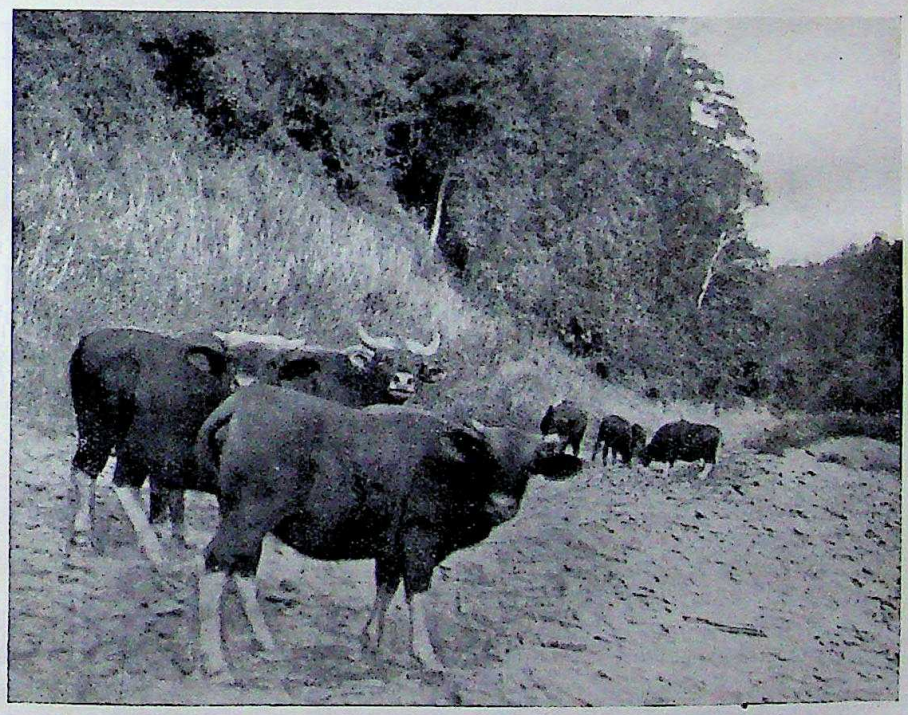


1. The Gayal or Mithun (*Bibos frontalis* Lamb.).



2. A herd of Bison (*Bibos gaurus* H. Smith) at a Salt-lick.

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considers himself to be a good shot and thinks he can place a bullet in the body of an animal in a fatal spot with his first shot nearly every time, and uses in consequence weapons of calibres such as 256, 280, 318, 375, 400, or 423. Such men, in my opinion, would set a bad example to the beginner when the latter essays out after big game, were they to suggest to him that he should start using one or other of the above mentioned weapons instead of recommending him to start his novitiate with a really reliable weapon such as a 450 or 500 bore cordite rifle burning charges of 70 or 80 grains of cordite. There are far more indifferent shots and beginners in this world, than there are experts, so far as big game shooting is concerned.

A bull bison shot through the intestines is a devil incarnate for at least four, or even five days, until peritonitis sets in and carries him off. For such bulky animals, bison can cover the ground when in full charge at a great pace and nothing but a heavy bullet with a big powder charge behind it of at least 80 to 100 grains of cordite placed in the vertebrae, or the brain of the animal, will stop them on these occasions. Some men who have had the luck to shoot two or three bison dead with one shot each on first going out after these animals with, say, a powerful small bore, such as a magnum 375 or a 318, make little of bison shooting in consequence, and imagine that these animals are easily disposed of. These men cannot, however, by any manner of means be permitted to be judges and until they have gone through the mill and have had the pleasure and experience of following up wounded solitary bulls, they can know nothing about it. 'But why wound an animal at all', I hear some one say, 'and have to follow him up and risk a charge,' 'why not hold straight in the first instance'? It is easy, of course to talk like that. I do not profess to be a trained Bisly shot moreover when I have been climbing up and down the steepest hills all day long, through the densest jungles and undergrowth imaginable, with the sweat pouring into my smarting eyes and my skin itching all over like the devil from brushing up against thorns, stinging nettles, hornets' nests, and the hair from the bamboos, it is not always so easy to hold as straight as one would like to. Consequently shots are sometimes badly placed thus necessitating the following up of an animal. There are very few men indeed who have not had to follow up wounded animals during their shikar experiences. Referring to the use of small bore rifles on dangerous game I knew one military Police Officer, P. S. by name, who went after a bull bison armed with only a 303 service rifle with which he had the luck to bag the animal with a single shot through the heart. He remarked to me on his return from his successful venture 'well after that a 303 is good enough for me for use upon any animal'. Another well known sportsman who contributes to the *B.N.H.S. Journal*, had his tensest moment with a tiger armed with only a 280 Ross. It is not what a weapon has done or may do on certain occasions, it is what it will or should do on every occasion and a good 'big un' is far better than a good 'little un'. In Burma one has sometimes to deliver at close quarters a

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knockdown blow in heavy jungle. This cannot always be done with a small bore rifle. One has to realize what an old solitary bull bison can take sometimes in the way of lead before he has been rendered *hors de combat*, which can only be accomplished by the brain or heart being pierced by the bullet, or the vertebrae of the neck being severed. A shot through the lungs is not necessarily immediately fatal. It depends a good deal on the extent of the damage caused in that region by the bullet. I have known of solitary bull bison getting away and recovering from lung wounds. The brain shot is a difficult one especially when the animal is facing one with its head thrown up. Moreover, one is liable to damage the horns in these cases. It is always well to shoot low when taking the shoulder shot. A novice is likely to be deceived by the size of the dorsal ridge, a shot through which only causes a temporary collapse of the animal, which generally rises and makes off again none the worse. If charged by a bison the only thing to do, unless the sportsman can make certain of his shot, or in case he cannot retreat behind the trunk of a tree, bamboo clump, or rock, in time, is to throw himself on to the ground at full length and chance the beast overstepping him when passing over him in his stride, as happened to me on one occasion (an account of which will be described later on). The animal cannot pull up until he has overshot the sportsman by at least 20 or 30 yards. The bull may, however, turn round again and repeat his charge and hunt the sportsman as a terrier would a rat, and unless he can spring to his feet in time and kill the animal before it reaches him he is in for a 20-foot toss, if he is not badly gored or killed on the spot. An old bull bison has such a short thick massive neck that he is generally unable to lower his horns sufficiently to be able to pick up and toss a human being lying flat on a level piece of ground. To think of escape by running when charged by a bull bison is to court almost certain death. Never approach a bison that may have been floored if its eyes are closed and there is an occasional flicker of the eyelids or ears, as this means that the animal is not dead. Only when the eyes are staring wide open and still can you assume him to be dead. A number of men have been attacked or gored to death through coming too near a seemingly dead bison. Always bombard the body from a safe position with a few sticks or stones before approaching too near or administer a *coup de grace* in the shape of another bullet through the head or neck. With rare exceptions there is no animal in the East, other than the rhinoceros and the tapir which avoids man's proximity more than the bison. The Banting (*Bibos sondaicus*), the true wild cattle of Burma, is usually found nearer villages than bison. The size of a bison can generally be gauged by the size of his hoof marks. I have on several occasions seen tracks very nearly as large as those of a half-grown bull buffalo, although a bison for his size has ordinarily very small hoofs. It does not necessarily follow, however, that large tracks indicate that the owner possesses large horns, for several very large bulls shot by me of over 19 and 20 hands with large hoofs had inferior horns, so what the animal gains in bulk

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he seems to lose in size of horn. The owners of some of the finest heads shot in Burma had on the whole, small but rather long and wide hoofs. Regarding dewlaps I have noticed that very few bison shot by me had a pronounced dewlap whilst others had only a slight thickening of the skin. A bison's sense of smell is very keen, so stalking them, unless the wind is in one's favour is not easy as some think. The Gayal or Mithun (*Bibos frontalis*) (see Pl. I, 1) is another animal which looks like a bison as he exudes the same oily sweat from his skin and has a very similar odour. The skin, hair and general appearance are almost identical. These hill cattle are kept by the hill people such as the Kamis and Chins solely for sacrificial purposes, and to hand over as dowries by the hill people of the Arakan Hill Tracts, Chin Hills of Burma, Manipur, Assam and elsewhere. They are not used for milch or agricultural purposes. The hill people, as a matter of fact, consider milk a most disgusting fluid and will never use it, quite forgetting, nevertheless, that as babies they were brought up on it. Solitary bull bison in the Arakan Hill Tracts of Lower Burma frequently enter the cultivations and villages of the hill people to consort with the herds of mithun kept by them. I sent a crossbred animal, i.e. half bison and half mithun, from the Arakan Hill Tracts, with four or five pure mithun, to the Rangoon Zoological Gardens some years ago but I am afraid they are not likely to thrive as these animals must have plenty of shrubs and green bamboo leaves and shoots on which to browse. I have watched a bull bison accompany a herd of mithun right up to a village in the Arakan Hill Tracts at dusk and pass the night there with them within 20 or 30 yards of the village. It stayed there the whole night. At daylight, when it would go off to a neighbouring jungle-clad hillside to lie up, invariably joining the mithun again in the morning when these animals turned out to graze in the neighbouring clearings. This particular bull was somewhat of a nuisance for the women drawing water from a stream near by the village used to meet him often. The only notice he took of them, however, was to snort and toss his head at them which caused them to run back screaming to the village. The villagers wanted me to shoot him, but I declined to do so, pointing out to them that the animal was useful, as he was infusing new blood into their herds of mithun. It seems however that the offspring of a cross between a bison and a mithun are a little wild. The hill people find them more difficult to catch when they require an animal to be killed for a feast or for sacrificial purposes even though the usual handful of salt is offered. It is well known all over the Arakan Hill Tracts of Burma that bull bison consort freely with mithun and that the former seem to get accustomed to the presence of human beings to such an extent that they do not make off into the jungle on scenting, or seeing them, but simply slip quietly away and lie up close by.

I suppose that the mithun is a cross between ordinary cattle and bison many generations back out of which has evolved the present species. I have not seen Mr. Stuart-Baker's note on the relationship between bison and mithun, and I have never seen

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a wild mithun nor have I ever met or heard of any one who had ever seen or shot one. I do not understand, therefore why we are still given licenses to shoot mithun. Is it a jest on the part of the Forest Department? During the past 45 years of my residence in Burma I have on numerous occasions, when in the dense forests of Burma, been seated on the ground surrounded on all sides by bison for fairly long periods studying their habits and the sounds emitted by them, from calves upto full-grown cows and bulls. I have often also sat on the ground in the jungle for many minutes at a time within a few yards of many old solitary bull bison on different occasions, and listened to their deep breathing sounds whilst they chewed the cud, tossed their heads, and swished their tails about from side to side to keep off the flies. Although I must confess to having shot many wild animals in my time, it has always given me the greatest pleasure to be in their midst watching and photographing them and endeavouring to see how near I could get to them without being discovered. Photograph No. 2 (Plate I) depicts a herd of bison at a salt lick partaking of the waters to get rid of internal parasites. All animals, as is well known, visit salt licks for this purpose. In the fly season, that is to say from March to the end of June, these being the hottest months of the year, all large game like elephants, bison, and tsaine are more irritable from the bites of gad flies, mosquitoes, and other flies. At this time they are more dangerous and more on the alert. In order to escape from the bites of flies most animals, such as sambar, bison, elephant, tiger, tsaine and barking deer, prefer to lie up in heavy jungle unless they can find some suitable high open ridge, where a good breeze is blowing. I remember seeing an old solitary bull tsaine in the Momeik State of the Ruby Mines District, Upper Burma, careering along through some fairly open country past me in May, during the hottest time of the day as if the devil were at his heels, seemingly oblivious of my presence, surrounded by a black cloud of gad flies, and shaking his head from side to side in his maddened efforts to get rid of them. These flies are only found in certain dry belts of country where a growth of 'Eng' sal or bastard teak predominates. The bites are most irritating for both man and beast and blood is freely drawn. I remember once having to gallop on horseback fairly quickly through a belt of five miles of similar fly-infested country, referred to in Burma, as 'In' or 'Eng daing', in the Ruby Mines District, in order that my pony and I might escape to some extent the onslaughts of these pests.

I have noticed during the many battles-royal witnessed by me between solitary bull bison on the one hand and between solitary bull tsaine on the other that they as a preliminary to an attack generally approached each other sideways with lowered heads in a half circle pawing the ground occasionally and uttering at the same time half-suppressed snorts or spurts of air from their nostrils and throats. At other times they seemed to draw in their breath making at the same time a low, double, half-suppressed, indrawn guttural sound. The fight generally ended after they had battered each other in a silly sort of way with their horns by one

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bull chasing the other away and prodding it the while from behind as it made off, in the same way as fights generally end between domesticated buffaloes and ordinary cattle. It was never a fight to death, as often happens between tusker elephants. I have never seen or heard of any fatal encounters between bull bison or between bull tsaine, the reason being, I think, that the horns of these animals especially bison are generally either too curved or too blunt to enable them to inflict a fatal wound whilst their hides are also thick. There is no doubt, of course, that they do gore and injure one another rather badly at times, but these occasions are very rare indeed. The formidable horns of a buffalo are far more likely to inflict a serious wound on the body of an animal. I once came on two bull tsaine hammering away at one another in a duel to such an extent that they did not see my approach till I was within 8 or 10 yards of them. I shot the bigger animal of the two and the other one bolted, but on hearing the death bellow of the dying animal it returned to the attack in spite of my presence and only went off at a slow trot when I shouted at it. On one occasion I came on a herd of bison in the Yoma Mountains on the watershed between Arakan and the Thayetmyo District of Burma away in the blue, that had treed a leopard, which, no doubt, had attempted to carry off a calf. I was attracted to the spot during a short halt for breakfast by hearing at intervals a succession of raucous grunting noises. Agreeing with my hunter, Tha Yauk, that the noises we had heard must have been made by a couple of bears fighting over a nest of bees, I armed myself with a double hammerless 303 rifle and taking Tha Yauk with me went off to reconnoitre. After going some way we came upon bison tracks, and finally some 15 to 20 paces off, burst upon a scene that gladdened my heart, for there on a fork of a large tree, some 15 feet from the ground, was a large leopard snarling like the devil and showing his teeth at intervals, whilst he glared at a circle of bison that stood stolidly round the base of the trunk of the tree pawing the ground with their hoofs and uttering at intervals the low peculiar half suppressed double indrawn guttural sounds, which are usually made by the majority of bovine animals when they are annoyed, and want to fight. No bellows were uttered at all. There is a vast difference between a bellow and the low guttural half-suppressed indrawn sounds referred to, uttered by these animals. The leopard was the first to either wind or see us, for he took a mighty leap from his perch, clear of the bison, his tail swinging round and round in mid air, to enable him to maintain his equilibrium. The herd scattered almost immediately after the disappearance of the leopard without a shot being fired and the jungle became dead and silent once more. It was now apparent that the noises we had heard had been made by the leopard as well as by the bison. Bison have only two enemies to fear, viz. tiger, and man, but the former is no match for a full-grown bull and it is only when a bison feels his end is approaching through old age, disease or wounds, that he succumbs to the repeated attacks of a tiger; but, even then, the latter has usually to put forth all his cunning and his utmost

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strength before he can hamstring and bring his mighty opponent to the ground. A tiger generally endeavours to hamstring all large bovine animals, such as bison, buffalo and tsaine when he can do it with impunity, although he has a wholesome respect for the horns of a buffalo. When there is a herd of domestic buffaloes about, of course a tiger usually hasn't a look in.

A description of the various sounds and calls emitted by bison may not be out of place here. I will first describe the sounds uttered by a bison when he has been (1) alarmed and (2) when he is at bay. Call No. 1 is the well known startling loud whistling snort of alarm, which is emitted when the beast has either winded or seen a human being. Call No. 2 is a low deep rumbling long-drawn-out menacing note or challenge, which is only sounded when a bull, not necessarily disabled, is standing at bay and means business. There is no mistaking the meaning of the sound as I have heard it on several occasions and it is a warning that the animal is annoyed and will charge on scenting or sighting the hunter. The sound, in fact, is not unlike the low rumble of distant thunder or that uttered by an elephant.

Call No. 3 is a low 'Moo' a kind of note of apprehension, suspicion, or alarm which is uttered, by a bison when he has seen the hunter without winding him or realizing what to make of him. Call No. 4 is a long-drawn-out sonorous roar which is usually uttered by a bull or leader of a herd and is very similar to that emitted by an elephant. Many European sportsmen have been deceived on hearing this roar into believing that it has emanated from an elephant. This call, or roar, for it cannot be called a bellow, is generally uttered by an old bull or leader of a herd as a call, or signal, to its companions that may be resting for the day, that it is time to turn out and feed. The same call, i.e. No. 4, is also uttered by the leader of a herd to bring the herd together when it has been decided to trek for new feeding grounds. On these latter occasions the animals generally go a considerable distance before they settle down and begin feeding again in their new feeding grounds. I remember being within 200 yards or so of a herd of bison one very hot afternoon in April at about 4-30 p.m. My hunters and I had been following the spoor of a bison which, judging by the size of its tracks was a very large animal. The tracks, in fact, looked like those of a buffalo, so large were they. The surrounding jungle was very still and hardly a breath of air stirred the leaves of the trees. My hunters suggested a halt of half an hour before going further in case we should disturb the bull resting. We accordingly pulled up on reaching the bed of the Ru, a stream some 45 yards in width with bushes and undergrowth scattered about along its bed and banks. We had hardly been seated 25 minutes when our ears were greeted by the sound of the snapping of a bamboo from the bank of the stream on our left, some 80 yards off, followed by the appearance of a very large bull bison which suddenly stopped dead, raised his nose slightly in the air, and uttered the well-known, loud continuous sonorous roar or signal. Almost immediately after the reply to the summons came, for we heard the distinct patter

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on the leaves and twigs of the rapidly moving feet of large animals coming towards us from the opposite side of the stream to our right. Had anyone tried he could not have succeeded in placing us in a better position to witness the whole affair. There was no getting away from the fact that the bull's roar was a signal to the herd which was resting in the jungle on the opposite bank, that it was time for the herd to come out and graze, or that it was a signal that they were about to trek for new grazing grounds. I have often heard this roar used for both purposes. The same call or roar is also used by the leader of a herd to summon any laggards that strayed or remained behind in the grazing grounds when the rest of the herd have moved off from the grazing ground, say at about 8-30 a.m. into the cool recesses of the adjoining jungle to lie up during the heat of the day. The bull almost immediately after uttering his trumpetlike summons became suspicious that things were not as they should be, for he suddenly raised his head and looked fixedly in our direction. My first shot from a 500-bore cordite rifle burning 80 grs. of cordite got him in the neck but failed to stop him as he raced down towards the opposite bank of the stream. The second bullet, however, got him in almost the same place smashing his vertebrae and bringing him to the ground with a crash. He turned out to be a very large animal measuring as accurately as I could take it with a steel tape a little over 20 hands. The head measured 80 inches from point to point, outside measurement, taken straight across the forehead at once, which in my opinion is the best way to measure all the heads of the oxen. A fifth call, or low 'bhay' may occasionally be heard by any observant sportsman who has had long experience of the jungle. This call is usually uttered by a member of a herd that having become separated from its companions, owing to their having been disturbed by human agency, desires to rejoin its companions. This sound is a subdued bellow. It is, in fact, a note which has been made purposely low so as not to attract unduly the attention of its enemy—man. The sound of this 'bhay' never travels very far, not further than perhaps a distance of from 350 to 500 yards at most. With regard to call No. 3, already described, this 'moo' is really one of apprehension, perplexity, suspense, or uncertainty, call it which you will, which is uttered by bison when they have spotted something they have not winded and cannot quite make out. I will give you an instance of this in my own experience. When out with my men on one occasion, on the watershed of the Yoma Mountains between Arakan and Thayetmyo District we suddenly came on a herd of bison that was lying up in the jungle during the heat of the day. A portion of the herd saw us at the same moment, but my men and I allayed their suspicions by throwing ourselves flat on the ground and remaining still. The animals, whose nervousness was quite apparent, although they saw us move, had not winded us. They stood stock-still at first, craning and twisting their necks from side to side in their efforts to try and make out what we were, uttering at the same time at intervals the low husky suppressed 'moo's' referred to above.

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Then, when evidently they could stand the tension no longer, some four or five young bulls and cows began to walk slowly towards us in a very hesitating manner, still uttering from time to time low 'moo's', and lowering and raising their heads in an endeavour to get our scent. I have not the slightest idea what they took us for, a tiger perhaps, but when they had approached to within four or five paces of us I thought it time to spring to my feet and stampede them as I did not relish being trampled upon or gored even though they were only young bulls and cows.

Mr. Dunbar-Brander (see pages 151 and 153 of his admirable and popular work *Wild Animals in Central India*) states that bulls bellow with rage. He says 'I had shot a bull in the middle of a grass maidan. The herd bolted a short distance and then returned to their fallen lord. The herd excited and angered at the smell of the blood commenced to bellow and paw up the earth.' The pawing of the earth is a common enough occurrence amongst even domestic cattle but I am of opinion that both the bellowing and the pawing of the ground on this occasion was not due to rage so much as to panic and fear brought on by the smell of the blood and by their desire to be with their stricken leader whose death, moreover, they were unable to connect with the shot whilst they also thought, perhaps, he might yet be able to rise to his feet. It was only after hearing the human voice that they realized the truth. So far as my experience goes, I have never heard of bison bellowing in a rage. I am of opinion, in fact, that they only bellow, as do all domestic cattle when they are in a panic or in mortal fear. I have seen many head of cattle lassoed and thrown to the ground to be castrated, doctored, or branded and in the majority of cases they nearly all bellowed in terror. Then, again, the five mithun and the animal which was the result of a cross between a bison and a mithun, which I sent from Arakan to the Rangoon Zoo some years ago, all bellowed pitifully when they were being hoisted on board ship. A sixth note which may be referred to as being uttered by bison, is the long-drawn-out death call which is uttered by a bull in its death throes. This roar, or death call, is not so loud, prolonged or as sonorous as the roar uttered by the leader of a herd when (1) he asks the herd to come out and feed, when (2) he asks them to trek for new feeding grounds, and when (3) he is calling up the laggards to hurry up and join the rest of the herd and get a move on out of the grazing grounds.

Three large solitary bull bison that I wounded on different occasions waited for me to come up with them after uttering the low long-drawn-out deep rumbling warning notes peculiar to these animals. Old solitary bull bison although they may seem to have lost all sexual instincts are yet found either following the tracks of a herd or in the vicinity of one in the hope of annexing a female sooner or later.

An old man of 75 years of age or over still has sometimes a hankering after the fair sex.

Solitary bull bison occasionally visit remote hill cultivations planted out in paddy and Indian corn as I followed up and shot

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a very old bull eating the young rice plants in a cultivation situated about 600 yards or so from a Chin village. This village I should state was a long way from other villages. I once came across the largest solitary cow bison with the finest pair of horns for a cow that I have ever seen. My hunter and I examined her very carefully at fairly close quarters through a powerful pair of binoculars and he informed me that she would be dropping a calf in a day or two. My experience goes to show, however, that cow bison drop their calves invariably when with a herd and that the latter as do elephants generally rest for two or three days until the calves are strong enough to move on. This cow through having been disturbed may have become separated from the rest of the herd, but she seemed to be in no hurry and in no way perturbed as she was grazing and moving along quite unconcernedly. To say that solitary bull bison are not given to charging is hardly correct. Solitary bulls in Burma have been known to charge without any provocation whatsoever on sometimes scenting as well as on sighting a human being. Many cases of this kind have occurred in Burma to my knowledge. Mr. King of the Survey of India was recently charged and killed by a solitary bull bison near Taungdwingyi, in the Magwe District. He and a companion apparently, when on duty in the jungle, suddenly came upon the animal, which charged at once in spite of being shouted at. Shouting at some wild animals in an attempt to drive them off is by no means always successful, especially in the case of a solitary elephant. The human voice in some cases often causes an animal to charge, especially in areas where game has been fired at and frequently disturbed. I was once charged by a very truculent old bull bison I was tracking up very cautiously accompanied by a hunter. He came down on us so suddenly through thick stuff from a distance of about 40 yards that I could not see him until he was almost on us. In fact, I had barely time to get out of his way. However after overshooting my hunter and me by about 25 yards, I could see he meant business, for he turned round and came back at us again full tilt. I killed him this time with a lucky shot in the brain.

Some years ago when after bison in the Tavoy District of Lower Burma, along the upper reaches of the Tavoy river beyond a place known as Mijyaunghlang where a morass of hot sulphur springs are to be found, I had an unpleasant experience with an old bull bison which nearly got me. We, that is to say a Karen hunter named Maung Ba Han Tha and I, had just struck the trail of a large solitary bull bison. It was raining at the time. The tracks led into a thicket of low dwarf bamboo jungle into which we cautiously picked our way. The noise of the rain falling on the leaves of the jungle drowned any little sound made by us. It was impossible to see more than 8 or 10 yards ahead. Ba Han Tha was armed with a single-barrelled 8-bore breech-loading gun which burned 8 drs. of powder and carried a heavy spherical ball. I was armed with a double 8-bore rifle, which took a charge of 10 drs. of powder and a heavy conical bullet. We had not gone more than 20 yards into the patch of bamboo when I caught sight

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of a motionless black patch about the size of a large saucepan not 12 paces off. It was very fortunate for us that the wind was blowing in our favour, i.e., from the animal to us. I did not hesitate a second longer than was necessary, but fired into it at once, as the beast seemed to me to be suspicious and standing stock-still as if listening. There was a crash on the report and away went the bull making a terrific clatter as he smashed his way through the bamboos at a fast gallop. Now came the exciting time. I could not tell where I had hit him but in duty bound we had to follow. There was a certain amount of blood spoor on the ground and judging by the height of the smears left by the wound on the stems and leaves of the surrounding bamboos, as the animal forced its way through the jungle, I would appear to have hit him on the body, too far back in the intestines. After following the animal for about two miles or so we lost the tracks, whilst no blood could be seen on the ground. Bison often have a thick layer of fat under the skin especially about the beginning or end of the cold weather, when they are generally in good condition, and do not in consequence bleed much externally. One would be surprised to see how little blood escapes sometimes from a wound of this kind, which often closes up. If this happens the result is that internal haemorrhage sets in which naturally makes it much worse for the animal especially if he drinks water at any pool or stream as he moves along. All this seems very bloodthirsty and unnecessary, but it is meant more to assist and to initiate the novice in the art and mysteries of big game shooting. However, just at this juncture as Ba Han Tha and I were separated about 30 paces apart casting around most anxiously for the tracks and blood spoor of the bison, which, by the way, had been going up wind all this time, as most wounded animals generally do, to get the scent of those following, there was a loud crash, and before we had realized what had happened, the wounded bull was charging straight down upon us at a great pace. There was no time to do much, but, fortunately, the jungle in that locality was not thick, and one could see ahead and around for 20 or 30 paces clearly enough. The bison in his mad determination to get one or other of us just missed Ba Han Tha by about a foot, he having jumped to one side behind a tree in time. I had nothing to get behind and to make a bolt for it was quite out of the question. As the bison was almost on top of me I threw myself over flat on the ground to one side clutching the heavy rifle with my right hand. The animal took me in his stride crossing over my legs. I could almost have counted the black hair on his wet jet black muzzle, as he shot over me. I remember wondering at the time as I lay, which foot would come down upon me and why the brute did not stop to gore me, for it did not strike me at the time that he had missed me, and that he was travelling so fast that he could not possibly pull up until he had overshot me by a good many yards. I was up and on to my feet again and round like a flash for, after overshooting me by some 25 or 30 paces, he pulled up on to his haunches scoring the wet ground with his hoofs for nearly 8 or

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10 yards in the mighty efforts he made to pull up, and wheeling round came back at me again full tilt, with lowered head evidently meaning to finish either myself or Ba Han Tha. I fired my first shot somewhat hurriedly as he wheeled round. This shot as I afterwards discovered gave him a nasty flesh wound in the side of the chest without doing much damage or reducing his pace in the slightest and he was almost on to me, within 3 or 4 paces, in fact, when my second shot got him fairly in the centre of the neck and after ploughing a hole clean through it found a resting place in the animal's stomach. This lucky shot which smashed the vertebrae crumpled him up at my feet like a sack of potatoes pitched out of a cart, for he collapsed on to his head, and after turning a complete somersault, rolled over and remained motionless, with the exception of a tremor here and there, and uttering at the same time a long-drawn-out mournful bellow. It was certainly very exciting whilst it lasted, too exciting in fact, and I must admit I was shaking like a leaf from the excitement when it was all over. The bull when he collapsed fell with one leg over my discarded rifle, which I had flung from me after the second shot, intending to make a bold bid for freedom should I not bring the animal down with my second shot. In the heat of the moment I quite unjustly cursed Ba Han Tha my hunter for not firing at the bison as it passed over and returned at me. I was quite wrong, however, in doing this and made amends afterwards for what I had said, as he explained to me quite correctly that it was quite impossible for him to fire either when the bull was passing over me or even when it was coming back at me for fear of hitting me as I was more or less in the line of fire. Moreover, as he reminded me he had never fired a gun of the description he was carrying before and was unaccustomed to its use. My first shot I found after holding a post-mortem had hit the bull through the ribs on the right side and had found its exit on the opposite side. This bull, had I not got him, would certainly have hunted Ba Han Tha or myself as a terrier dog would have hunted a rat. His horns measured 79 inches from tip to tip outside measurement across the forehead. The girth of each horn was 19 inches. The bull itself measured a little under 20 hands.

I shot a very fine old solitary bull bison near the Pidaung Plain, in the Myitkyina District of Upper Burma which was blind of one eye, the right one and minus his tail. When I was following this animal's tracks on foot at 8 a.m. one morning it looked to me as if he was heading for the railway line with the intention of crossing it and entering the Pidaung Plain, now a game sanctuary. I was following the bull armed with a single-barrelled take down 577 cordite rifle by Messrs. Westley Richards, which took a charge of 100 grains of cordite, and was accompanied by a very good Kachin tracker. We were nearing the railway line carefully picking up the tracks and keeping our eyes and wits about us when I suddenly caught sight of the bull coming back on his tracks having been evidently disturbed by some coolies coming along the railway line. He was a monster. We met at about 15 paces. I happened

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to be on his blind side and as he passed me I let him have a shot behind the shoulder. I had opened out a fresh tin of ten cartridges that morning with soft nosed bullets. On receiving the shot the bull collapsed into some 'theke' grass, some four or five feet high, a kind of grass which is commonly used by the people for thatching the roofs of their houses. I immediately sent the tracker up an adjacent tree to see what had happened. No sooner did the Kachin begin to make a rustling noise in his ascent of the tree than the bull rose to his feet and came blundering along in my direction to try and get at me without however knowing my exact position as I was still, as I afterwards discovered, on his blind side. I had by now inserted another cartridge into the chamber of the rifle and let drive at him again. He collapsed again on receiving the bullet not five yards away; but, as he was struggling hard to regain his legs once more I finished him off with a third shot, which got him in the neck and severed the vertebrae. Had I been using a small bore rifle, such as some men use upon these animals, I am afraid it would not have fared very well with me. The bullets from the first two shots had made their exit on the opposite side taking a large amount of the contents of the stomach with them which showed that they had mushroomed properly and done their duty. The bull's tail had probably been bitten off short in some encounter with a tiger which had probably damaged his right eye at the same time. The animal's horns measured 86 inches from tip to tip across the forehead taken outside, and were beautifully corrugated. This bull measured a little over 20 hands at the shoulder, noted down after a very careful measurement. For a picture of this bull see Pl. II, 1. The elephants in this picture were used as baggage animals only.

I once used a double hammerless 303 upon a solitary bull bison when these weapons first appeared on the market, somewhere about the eighties or about the beginning of the nineties when they were very highly spoken of by men who had used them in Africa. I was on the top of the Yoma Mountains on the watershed some 4,000 feet above sea level far away from all villages. The summit was all open undulating country covered with short grass and ferns. The jungle and undergrowth came up from below on either side and ended off abruptly like a park at home. I was seated on a rock gazing into space as in a dream, devouring the magnificent view that lay stretched out at my feet to the west towards the sea when I was rudely aroused from my idle reverie by my hunter Tha Yauk's voice informing me that he saw two dark objects lying down on the grass out in the open some 600 yards or so away which he took to be sambar. My glasses soon proved that he was right and a closer inspection revealed the fact that two of the animals were stags with good heads. Leaving my 8-bore in charge of two men and telling them on no account to move from the grassy knoll we were then standing on, Tha Yauk and I strolled off to stalk the animals. The sambar were lying on an open grassy slope devoid of all cover and about 150 yards away from a narrow belt of densely wooded jungle some 30 yards in width which, fortunately, intervened and hid us from view.

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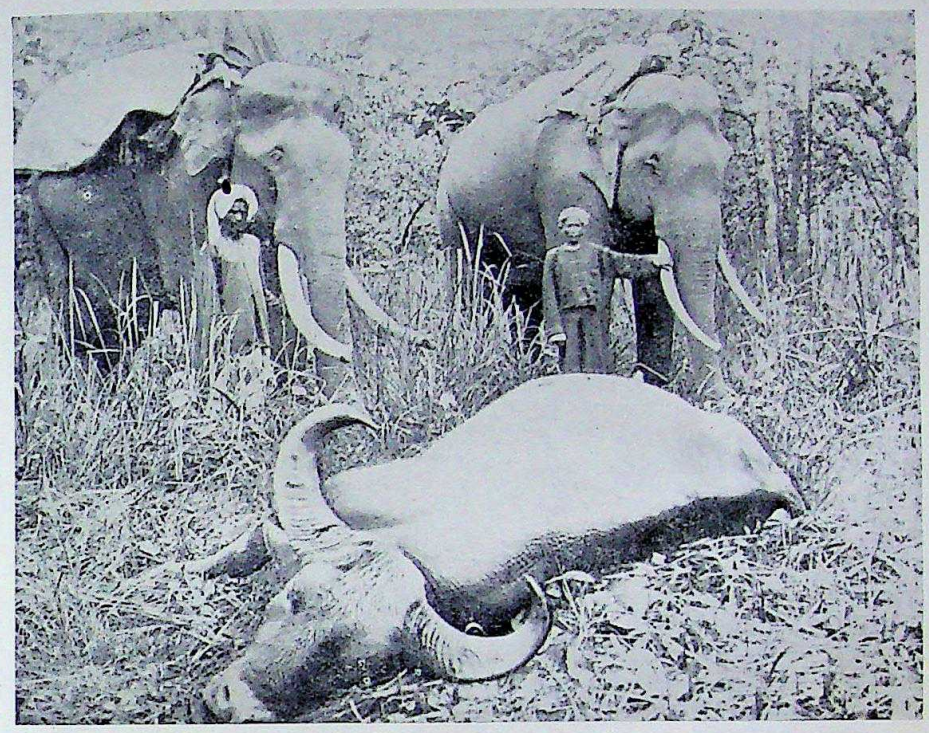
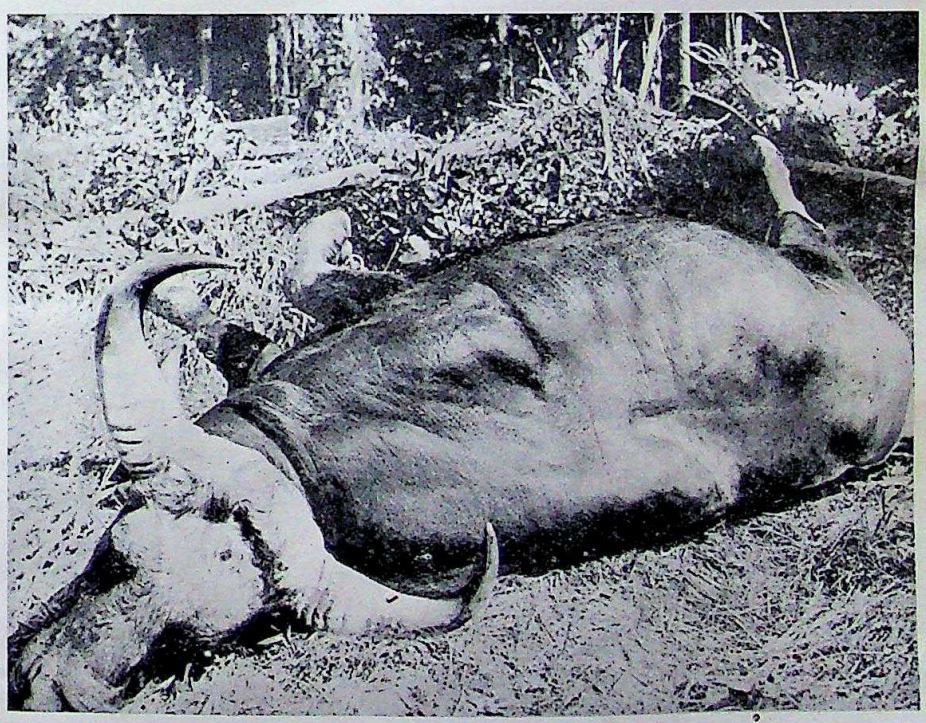


1. A solitary Bull Bison (*Bibos gaurus* H. Smith) shot near the Pidaung Plain, measuring 20 hands at the shoulder.



2. A solitary Bull Bison (*B. gaurus* H. Smith) shot at an elevation of 4,000 ft. in the Yoma Mountains.

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Telling Tha Yauk to lie down till he heard me fire I went down on all fours and commenced the stalk. One of the stags who was looking in my direction from the slope above some 300 yards off immediately came into view and then lay down. I thought at first I had been seen and hardly knew what to do as I was not prepared to risk a shot at the animal which was not lying in a very favourable position. While lying flat on the grass meditating as to whether I should risk a shot or not I was suddenly startled by hearing the sound of some large animal cropping the grass a short distance ahead of me. Raising my head cautiously above the grass I peered over a slight dip in the ground regardless as to whether the sambar saw me or not and to my utter astonishment in a hollow below me, only a few yards away I saw a solitary bull bison feeding head on towards me. To say that I received the shock of my life was putting it midly and as can be imagined I wriggled back again and joined Tha Yauk three times as quickly as I had moved forward to stalk the sambar. It may be all right sometimes for some men to tackle a solitary bull in the jungle with a 303 when you are behind the protection of a big tree or clump of bamboos, but to do so in the open, with not a tree or a bamboo in sight in the vicinity, is tempting providence. Tha Yauk after reconnoitring the bison's position came back with the information that as the animal was evidently grazing slowly towards a small cluster of rocks which jutted out slightly from the hillside some 50 or 60 yards above him, and about 150 yards from where we were, it would be more advisable to fire at him from the rocks instead of tackling him in the open where he was sure to charge and get one of us, even if I did happen to hit him in a vulnerable spot with the 303. If we lay out at full length flat on the rocks the animal would not be able to see us unless we moved but if he did spot us he could get at us easily from in front or from either side. Tha Yauk and I finally decided after a short palaver to take up our position on the rocks and trust to the 303 with solid nickel coated bullets. I had only 4 of the latter with me and 6 with soft noses. We did at one time think of sending back for the 8-bore and chance the animal remaining in the same position and not getting our wind, but gave up the idea.

Some people may perhaps want to know why I could not have killed the animal with one shot through the head considering it was only a few yards off and feeding head on to me. There are several very cogent reasons why I did not do so, one of these being that on one occasion I tried and failed at ten paces to finish off a wounded bull bison by putting a 303 bullet into the spot where I thought the brain lay.

Then again the brain pan of a bison is, if anything only a little larger than a breakfast cup. How much harder then would it be to place a bullet in the brain of an animal that was moving its head from side to side in the act of feeding? A bullet will sometimes even if driven clean through the head of a bison fail to bring him down. I once met a solitary bull bison standing facing me in some bamboo jungle on the watershed of the 'Yoma hills between Arakan and Thayetmyo'. The distance between us

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was about 25 paces. I fired at the animal's head using an 8-bore Paradox and hardened conical bullets driven by 10 drachms of powder. The bull on receiving the shot turned round as if unhit and galloped off for over a mile. I came up with him again after a stalk of about three-quarters of an hour but he got up out of some thick stuff, having heard my approach, and dashed away down a steep hillside at the bottom of which, however, he collapsed quite suddenly stone-dead. The bullet, I found after a careful examination, had hit the bull exactly on the centre of the muzzle, between and a little above the nostrils, and after passing clean through the head and neck without touching the brain, was picked out of the cavity of the stomach having pierced the liver and lungs in its course. Internal hæmorrhage had killed him subsequently.

But let me get back to the other bison. A small valley on our right enabled us to make a detour and take up our position on the bunch of rocks already referred to, unperceived by the bull. Two sambar, a doe and a stag, had in the meantime risen and were grazing quite unconcernedly about 100 yards above our position. The old stag I had first seen with the fine head, did not seem to mind our presence in the slightest, although he had watched us crawl up to the rocks and then lie down. He kept his head turned steadfastly in our direction, nevertheless, and occasionally flicked an ear or shook his head. I really believe that these sambar took us for some four-footed animals like themselves and that they had never seen any human beings before. There would have been a very different tale to tell, however, I expect had the wind been blowing from us to them for their instinct would have warned them then that all was not right and they would probably then have galloped off out of sight. The rocks upon which Tha Yauk and I were lying were flush with the slope behind us and although they jutted out a little from the face of the slope and had a drop of less than five feet in front looking towards the bison, there was nothing to prevent the animal charging us from in front, behind, or on either side. Our invisibility was our only protection. We arranged beforehand that if matters should not go well with us we were to make a bee-line for the jungle by the shortest route, a matter of about 100 yards or so. The bison had now taken up a position broadside on to us at a distance of about 40 yards, its left side turned towards us. Making myself as comfortable as possible, I placed my cap under one elbow, and my handkerchief under the other, as the rocks were rather rough, and after taking a deliberate aim fired for the point of the shoulder low down. The bull on receiving the shot spun rapidly round first to one side and then round again to the other side repeatedly with quick jerky movements in his endeavours to locate us, emitting at the same time through his nostrils two or three loud short sharp spurts of air, its whole demeanour and actions indicating the while a curious admixture of fury, fear and defiance. Finally, after swinging round and round backwards and forwards several times as if standing on a pivot in its endeavours to make out its enemies, it stood stock-still with its right side turned broadside on to us affording me another excellent shot, which I immediately availed myself of,

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letting him have another solid bullet clean through the right shoulder. This bullet took effect in some unaccountable manner on the other side, for the bull presently began to limp off slowly on three legs, the left foreleg which had been shattered at the shoulder, swinging free of the ground. Stepping off the rocks, regardless of dear old Tha Yauk's warning to remain and fire from where I was, and taking advantage of several bunches of grass and tall ferns I crept up unperceived to within about 10 paces of the bison and killed him with one shot which must have passed through his heart for on feeling the bullet he stood perfectly still for a second or two and then after lurching unsteadily forward from side to side in a vain effort to maintain his equilibrium, he collapsed and died after uttering the usual long-drawn-out death bellow followed by a few convulsive quiverings. (For the photograph of this animal see Pl. II, 2.) Had Tha Yauk and I been in the open in full view of this bison when I fired my first shot with the 303 things would not, I am afraid, have gone very well with us, as in all likelihood I would never have been able to stop the animal with my second or even third shot. There are no doubt some really powerful magnum small bore rifles on the market just now, that are capable of doing a lot of damage but I am of opinion nevertheless that no one should begin using them on large dangerous animals until they have first gained a very great deal of experience of such game armed with rifles of heavier calibres. The new 303 magnum cartridge, recently introduced, which has a streamlined bullet and whose official designation is 303 mark VII is said to propel a bullet to a distance of 5,500 yards as compared with the extreme range of the present service rifle viz. 3,600 yards, may make some difference in the efficacy of the 303 when used on certain kinds of game by experienced sportsmen.

If my readers will not be bored, I will relate the result of another encounter I had with a solitary bull bison which very nearly ended my career. I was out in the Thayetmyo Yoma hills between Arakan and Burma with a brother police officer, F. C. Annesley by name, who like many other old pals of mine have gone to that undiscovered land from whose bourne no traveller or animal returns. We left camp in different directions, each accompanied by our own hunters. I went westwards into the Arakan Yoma hills accompanied by my hunter Tha Yauk who alas has also gone to Nirvana. A—, not being much of a climber, skirted the valleys below in search of elephants, a large herd of which, with several fine tuskers were reported to be in the vicinity. My hunter and I reached the top of the watershed after some 3½ hours' steady climbing. The jungle on the top came up and ended off abruptly on either side like a park at home. It was all open undulating country with short grass whilst ferns, orchids and wild flowers abounded. Here, whilst admiring the view and soliloquizing on things mundane, I had the luck to witness in a small valley below devoid of all jungle a battle-royal between two fine sambar stags which were surrounded by an admiring retinue of about 8 or 10 does and young stags. It was the clash of their horns which could be heard a long way off as they

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met in mid air that had first attracted my attention. It seemed cruel, but we have all inherited to some extent in our breasts the savage instincts of our forefathers and I was determined to put an end to the contest by bagging the stag with the best antlers. This I succeeded in doing with a well placed soft nosed bullet from my 303. As it was by this time past sunset we started off downhill again towards camp by a different route to the one we had come by. When half way down, when it was almost dark I had three shots with my 8-bore Paradox at a solitary bull bison that was ascending the ridge down which we were making tracks for camp. The shots were fired in failing light at ranges varying from 40 to 50 yards and the bullets were as I afterwards discovered badly placed in each case. On receiving the second bullet the bull walked slowly behind a large bamboo clump and standing there uttered the low, deep, menacing warning, rumbling note, already referred to by me in a previous portion of this article. As it began to get too dark to enable me to align the sights of my rifle properly we decided to return to camp. Unfortunately in spite of my hunter Tha Yauk's wonderful knowledge of the jungles we took the wrong ridge down to the valley and had in consequence to camp for the night in the jungle under a bamboo clump. Next morning we reached camp at about 7 a.m. A— was very interested to hear about my experiences with the bison and stag sambar and said he would like to accompany me on the following day as he had never seen a bison dead or alive and would like to see one. 'Right oh,' said I, 'come along by all means.' I knew, however, what this meant viz. too many followers, and consequently too much noise, whilst Annesley was a big heavy man not in good training who could not walk through the jungle without making a deuce of a noise. After going a few miles, we were approaching the place where I had left the bison the evening before, when I heard the animal rise stiffly to his feet in a clump of bamboos some 40 yards or so ahead. It may be stated here that a bison rises from the ground with his hind legs first whereas an elephant does so with his front legs. Tha Yauk, my hunter, now whispered to me 'Sir, there are too many of us, ask the gentleman A— who steps so heavily to fall back a bit so that you and I can enter the jungle alone as the bull will most certainly charge us or make off altogether if we all go on together as we are doing now and if he charges some one is sure to be killed.' Tha Yauk was quite right of course and A—, like a wise fellow kindly consented to fall back about 150 yards with his men. I then went on ahead alone armed with the 8-bore Paradox with Tha Yauk some 40 yards to the rear. Nothing could be seen of the bull and although I guessed his whereabouts I could not see any portion of him. 'Anyway,' I said to myself, 'he must be pretty sick after having had three heavy conical 8-bore bullets into him the day before and cannot do much harm.' I reckoned without my host, however, as the old devil had plenty of life left in him still as I found out to my cost. I was standing between two large bamboo clumps which were about 8 or 10 feet apart bending forward peering intently into the bamboo jungle ahead with the 8-bore held in my

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right hand across my right knee with my left hand resting on my left knee to see if I could see him as the jungle was by no means dense. Just then there was a loud crash and out came the bull at me travelling, for a wounded animal, at a great pace. He had evidently been waiting for just such a moment. To say that I was taken aback was putting it mildly. It took the bull such a short time to cover the distance between us that all I remember having time to do was to cock the hammerless action of my rifle when he was about five paces from me, and take a flying leap to my right behind one of the two clumps of bamboos I had been standing between. The bison swerved to his left at the same time with me, and, after carrying away a number of the bamboos of the clump I had jumped behind, lunged out at me with his horns, and caught me a nasty blow on my left thigh with the rounded portion of his left horn as he passed me, sending me spinning to the ground. It was a close call but I was up like a shot and went off limping and dodging in and out of the bamboo clumps like a wounded rabbit in the direction the bison had come from, fully expecting the bull to come back at me again any minute. Fortunately for me, he did not do so, but headed straight on into the jungles ahead. My thigh was bruised and sore, and took on all the colours of the rainbow that evening from my knee to my groin, but, fortunately no bones had been broken and I was not incapacitated from going at a slow walk. On the contrary, I was fit enough on the following morning to take on the bull's tracks again accompanied this time only by my hunter Tha Yauk. 'Sir', said the dear old fellow to me as we moved off stealthily on the trail of the bison like two leopards following up a deer, 'keep a careful lookout ahead, and on either side, whilst I do the tracking, as I am not as young as you are, whilst I am also a little deaf. Your eyes are good, Sir, and you have also good hearing. It would be a bad business for me if you were killed, as I might be blamed. This is a dangerous animal and his wounds will have made him vicious. He will most certainly charge and get one of us if we do not get him next time we meet him.' About 2½ to 3 hours after this, we had gone perhaps about 5 miles from the spot the bison had charged me the day before, and were proceeding cautiously down a densely wooded slope towards a stream known as the Bathi Chaung, when I happened to hear a very faint rustling sound ahead. The noise could have been made by a pheasant, or a barking deer, moving quietly through the undergrowth, so slight was it. Drawing Tha Yauk's attention to it at once by uttering a faint hiss, I pointed ahead and there sure enough, some 30 paces off amongst the undergrowth the black outline of the bull could be clearly seen standing stock-still head on like a block of black marble, ready to charge, the moment we reached the bottom of the incline. Poor brute! I suppose he thought he could not be seen. To let him have a right and left from the 8-bore Paradox was the work of a moment. A crash followed the two reports as the grand old beast dashed away only to collapse when he had reached the other bank of the Bathi stream some 70 yards away.

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THE HYDERĀBĀD STATE ORNITHOLOGICAL SURVEY

BY

SÀLIM ALI.

With Notes by HUGH WHISTLER.

PART IV.

(*Continued from page* 919 *of Volume* xxxvi).

FAMILY: PICIDÆ.

Dryobates mahrattensis mahrattensis (Latham). The Yellow-fronted Pied Woodpecker.

Picus mahrattensis Latham, Suppl. Index Orn. (1801), p. xxxi—Mahratta Country. [Restricted to Belgaum, Stuart Baker Fauna B.I., Birds (2nd. ed.), vol. iv, p. 46.]

Specimens collected: 56 ♀, 57 ? 8-10-31, 131 ♂? 14-10-31 Manānūr 2,000 ft.; 393 ♂ 30-11-31 Narsampēt 800 ft.; 628 ? juv., 629 ♂ 2-4-32 Utnoor 1,250 ft. The Sparrow Collection has ♂♀ 25-1-11 Jālna.

Elsewhere noted at: Nelipāka, Pāloncha, Āsifābād, Kaulās, Bhāmarvādi.

Iris reddish-brown; bill plumbeous, horny-brown on culmen; mouth greyish-pink; legs, feet and claws horny-grey or slate. In juvenile (No. 628) Iris brown; bill pale horny-grey, dusky on culmen; mouth pale pink; legs and feet lavender grey, claws darker.

[The Survey specimens measure as follows:

	Bill.	Wing.	Tail.	Tarsus.
♂♂	24-27	98-103	55-60	15-18 mm.
♀	23.5	100	59	18.5 mm.

and therefore belong clearly to the southern and typical form. The blacker brown and richer red of the lower parts, as compared with north-western specimens, are also typical. The specimens from Jālna in Col. Sparrow's collection also agree.—H.W.]

The Yellow-fronted Pied Woodpecker is generally distributed throughout the State. It is usually met with in pairs frequenting well-wooded country as well as light deciduous forest, mango-groves and the like, flying from tree to tree, often alighting on the stem near the ground and scuttling its way upwards, peering into the crevices of the bark and tapping from time to time to dislodge lurking insects. It was noted as a common constituent of the localised forest associations.

Breeding: On 18 March (Kaulās) a nest was located in the hollow vertical branch of a dry tree in open deciduous forest, at a height of about 18 ft. It contained chicks. The female parent brought a dragonfly; it approached the hole in a very cautious and circumspect manner, first alighting on distant branches then hopping across to the stem some way above the entrance-hole and surreptitiously sliding backwards and downwards to the hollow, uttering a concerned '*click, click*' from time to time. I observed identical manoeuvres in another case also.

No. 628 (2 April) was a juvenile with very imperfectly ossified skull and was attended by its male parent (No. 629) who carried a grub in his bill. The testes of the latter—measuring ca. 4×3 mm.—appeared to to be reverting to non-breeding condition. He had an incubation patch on the abdomen which suggests that both sexes share in incubation.

Davidson & Wenden (S.F., vii, 78) found this woodpecker common and breeding in suitable localities in the Deccan. Aitken (N. & E., ii, 306) records a pair at over 4,000 ft. on Singurh near Poona on 26 May.

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Dryobates hardwickii hardwickii (Jerdon). The Pigmy Woodpecker.

Picus (*Dendrocopus*) *hardwickii* Jerdon, Madras Jour. Lit. Sci., vol. xiii (1844-1845), p. 138—South India=Goomsoor.

Specimens collected: 58 ♂, 59 ♀ 8-10-31 Manānūr 2,000 ft.; 155 ♂ 17-10-31, 174 ♀ 19-10-31 Farāhābād 2,800 ft.; 382 ♀ 26-11-32 Pāloncha 300 ft.; 649 ♂ 4-4-32 Utnoor 1,250 ft.; 735 ♂ 22-4-32 Bhāmarvādi 2,500 ft.

Elsewhere noted at: Nelipāka, Kaulās, Itchora.

Iris pale lemon yellow; bill horny grey, dusky on culmen; mouth greyish-pink or greyish-magenta; eyelids and skin round eye magenta; legs and feet dark slate or purplish-brown; claws brown.

[The west- and east-Himalayan forms (*nanus* and *semicoronatus*) appear to me to be specifically distinct to the forms found in the Peninsula, and for the latter therefore *hardwickii* will remain the specific name. The genus *Yungipicus* cannot possibly be maintained (see Ticehurst, J.B.N.H.S., xxxiv, 169)—H.W.]

This little woodpecker inhabits secondary jungle and open deciduous forest, being met with singly or in pairs, usually the latter. On the Amrābād Plateau I commonly found it among the localised forest associations. Its actions and movements are often very reminiscent of a Nuthatch. I have noticed it on several occasions probing into the flowers of *Butea frondosa;* a specimen shot off these, however, had no pollen adhering to its bill or feathers. I also found it feeding regularly on the pulp of 'charoli' drupes (*Buchanania latifolia*).

Breeding: On 31 March (Itchora—Utnoor) a juvenile just out of nest was observed being fed by its parent. From the testes of No. 735 (22 April) it was apparent that it had finished breeding.

The gonads of the rest of the specimens gave no indication as regards breeding.

Brachypternus benghalensis Linn. The Golden-backed Woodpecker.

Picus benghalensis Linn., Syst. Nat., ed. x, vol. i (Jan. 1758), p. 113—Bengal.

Specimens collected: 98 ? 11-10-31 Manānūr 2,000 ft.; 157 ♀ 17-10-31 Farāhābād 2,800 ft.; 211 ? 1-11-31 Borgampād 160 ft.; 268 ♂, 269 ♀ 9-11-31 Nelipāka 160 ft.

Elsewhere noted at Kaulās, Bhāmarvādi.

Iris reddish-brown; bill horny-black; mouth slaty-pink or greyish-pink; skin round eye sage green; legs and feet greyish leaf-green; claws slate.

[This species is individually very variable in the features on which the subspecific distinctions are based and only a certain percentage of extreme specimens can therefore be definitely identified. All five specimens from the eastern side of Hyderābād are intermediate in character and match equally well many specimens both of *puncticollis* and of *benghalensis*. The upper parts are richly coloured as in *benghalensis;* the spotting on the throat is intermediate but more nearly approaches that of *puncticollis*.—H.W.]

The Golden-backed Woodpecker is fairly common everywhere in Hyderābād State, being more abundant in some localities than in others. It frequents gardens and compounds, mango topes, deciduous forest as well as scrub jungle with small trees, usually in pairs. Its food consists to a great extent of large black ants (*Camponotus compressus* ?) which the bird mostly picks off the trunk and branches of trees, sometimes even from the ground. The stomachs of two examined contained these insects exclusively. The tongue of a specimen preserved for morphological examination measured 133 mm.

Breeding: The gonads of all the specimens were in an undeveloped condition, but on two occasions (19 and 25 March, Kaulās) a bird was observed emerging from the same hole in a dry tree-stump at about 12 ft., where it was apparently breeding.

Chrysocolaptes festivus (Boddaert). The Black-backed Woodpecker.

Picus festivus Boddaert, Table Pl. Enlum. (December 1783) for Pl. Enlum. 696—Goa, India.

No specimen obtained, but Col. Sparrow's collection has a ♀ (evidently immature) 19-2-1911 Mirzāpalli, Deccan.

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I came across a pair of these woodpeckers on a thickly afforested hillside at Bhamarvadi (ca 2,500 ft.) on 23 April. The timbre of its call was easily distinguishable from that of the Golden-backed species, though the two are perhaps often confused.

Vidal records it as uncommon in Ratnagiri; Butler (S.F., ix, 385) mentions it from Dhārwār.

Jynx torquilla torquilla Linn. The Wryneck.

Jynx torquilla Linn., Syst. Nat., ed. x, vol. i (1758), p. 112—Sweden.

Specimens collected: 256 ?, 237 ♀ 3-11-31 Borgampād 160 ft.; 452 ? 11-12-31, 479 ♂ 16-12-31 Āsifābad 1,200 ft.

Elsewhere noted at: Narsampet, Mukher, Kāmāreddi, Bhāmarvādi.

Iris brown; bill brownish flesh colour; gape yellowish cream; mouth pale pink; legs and feet greyish leaf-green; claws dusky.

The Wryneck is a common winter visitor to the State. The last seen by me was on 21 April (Bhāmarvādi). It is met with singly or in pairs in open scrub jungle or about hedges etc. in the neighbourhood of cultivation. It hops about the ground in search of ants and other insect food remarkably like a finch, and its general behaviour and flight are also very finch-like. In Hyderābād I observed that it kept much more to the ground than to trees, only flying up into them when disturbed, but descending again to feed as soon as danger was past.

The organs of the specimens were in a quiescent state.

Family: Capitonidæ.

Thereiceryx zeylonicus (Gmel.). The Green Barbet.

Bucco zeylonicus Gmel., Syst. Nat., vol. i, pt. i (1788), p. 408—Ceylon.

Specimens collected: 27 ♂ 5-11-31 Manānūr 2,000 ft.

Elsewhere noted at: Farāhābād, Borgampād, Nelipāka, Pāloncha, Utnoor.

Iris hazel brown; bill pale orange-red; mouth pale pink; orbital skin orange, more reddish above eye; legs and feet pale lemon yellow; claws dusky.

[An intermediate specimen. It agrees very closely in colour with *Thereiceryx z. caniceps*, but is too small for that race, having a wing 117.5 mm. Five males in my collection measure 121.5-125.5 mm.—H.W.]

This barbet is purely a forest species and common in the forested tracts of the Telingāna, its call of '*krrrr, ku-troo, ku-troo*' etc. being in many localities one of the commonest bird voices in the jungle. I did not meet with it west of a line from Utnoor to Manānūr. Its food consists to a large extent of Peepal (*Ficus religiosa*) and Gulair (*F. glomerata*) figs.

The testes of the specimen were undeveloped.

Xantholœma hæmacephala indica (Latham). The Crimson-breasted Barbet.

Bucco indicus Latham, Index Orn., vol. i (1790), p. 205—India.

Specimens collected: 80 ♀, 81 ♂ 10-10-31 Manānūr 2,000 ft.; 225 ♀ 2-11-31 Borgampād 160 ft.

Elsewhere noted at: Farāhābād, Hyderābād City and Environs, Singarenni Collieries, Nelipāka, Kaulās, Utnoor, Bhāmarvādi.

Iris brown; eyelids coral red; bill dark horny-brown or black; mouth pale pinkish-grey; legs and feet coral red; claws black; soles yellowish.

The Coppersmith is a common and familiar bird throughout the State affecting gardens and groves as well as forest. When the various species of *Ficus* are in fruit these birds invariably collect on the trees to feed in company with Mynas, Green Pigeons and numerous other frugivorous species.

Breeding: The gonads of the specimens were in non-breeding condition.

On 19 March one was observed feeding young in a nest-hole in a decayed branch ca 25 feet up in deciduous forest, and another on 22 April was similarly occupied. In the latter case the chicks—two in number—were three-quarter fledged. The nest hole was about 12 ft. from the ground. On 20 April a bird was busy excavating in a dry branch.

Both parents appear to assist in feeding the young.

In Belgaum, Butler took nests from 11 February to 25 March (N. & E. ii, 332).

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Family: Cuculidæ.

Cuculus canorus or **C. micropterus ?**

I constantly observed some species of cuckoo of a slender build, somewhat smaller than a Shikra and with longish tail, flying about singly high up over the Amrābād Plateau. Unfortunately no specimen could be secured; hence its identity must remain doubtful.

The Sparrow Collection contains a specimen of *Cuculus canorus* labelled: ♀ 22-9-12 Trimulgherry, on which Mr. Whistler comments as follows: 'This specimen belongs to the paler type (with the undertail coverts lightly barred) which is usually called *telephonus*. In view, however, of my own experience that both *canorus* and *telephonus* types are found breeding in the same area in Kashmir territory and E. V. Kozlova's opinion (Ibis 1932, 588) that *telephonus* cannot be admitted as a valid race, it appears wiser to keep this record under the typical form.

Hierococcyx varius Vahl. The Common Hawk-Cuckoo.

Hierococcyx varius Vahl., Skriv. Nat. Selsk. Kjöbenhavn, vol. iv (1797), pt. i, p. 61—Tranquebar.

Specimens collected: 142 ♂ (imm.) 16-10-31 Farāhābād 2,800 ft.; 282 ? 16-11-31 Nelpāka 160 ft. The Sparrow Coll. contains the following: ♂ 31-1-12, ♂ 1-2-12, ♂ 26-2-11 Trimulgherry.

Elsewhere noted at Āsifābād, Kandahār, Mūkhēr, Utnoor, Bhāmarvādi.

In adult: Iris orange-yellow; eyelids same; bill greenish-brown, black on culmen; gape yellow; legs and feet chrome yellow; claws duskier.

In immature: Iris dark grey; eyelids greenish-yellow; bill orange-yellow, greenish at base of both mandibles; gape and mouth bright lemon yellow; legs, feet and claws chrome yellow.

The Hawk-Cuckoo or Brain-fever Bird appears to be fairly generally distributed throughout the Dominions. It haunts gardens, mango topes, scrub jungle and deciduous forest, and is usually met with singly. The flight—a few rapid wing beats followed by a little sailing—and its habit of shooting up into the branches of a tree before alighting are exactly like those of the Shikra (*Astur badius*). Many small birds are sufficiently taken in by its appearance to sound the alarm, and I have constantly noted the flutter it causes among them.

Its monotonous 'Brain-fever' call was noted as the earliest bird note at Bhāmarvādi, being frequently heard between 2 and 3 in the morning, and sometimes throughout the night.

Breeding: No. 142 (16 October) was one of two immature birds being tended by a pair of *Turdoides s. malabaricus*, under which species a fuller account of them has been given. The clamour of the young sounded like some of the harsh single notes occasionally uttered by the Rose-ringed Parakeet (*Psittacula krameri*).

Cacomantis merulinus passerinus (Vahl). The Indian Plaintive Cuckoo.

Cuculus passerinus Vahl, Skriv. Nat. Selsk. Kjöbenhavn, vol. iv, pt. i (1797), p. 57—Tranquebar.

Specimens collected: 90 ♂ 11-10-31 Manānūr 2,000 ft.; 249 ♂ 5-11-31 Borgampād 160 ft. The Sparrow Coll. contains the following: ♂ 30-11-10, ♂♀ 16-6-11 Trimulgherry.

Elsewhere noted at Hyderābād City and Environs, Narsampēt, Kandahār.

Iris bright orange-red in No. 90, khaki in 249; bill horny-brown, tinged with orange-red at base of lower mandible in 90, greenish-brown in 249; gape and mouth bright orange-red (brick-colour) in 90, gape yellow, mouth pale yellowish brick-red in 249; legs and feet brownish-yellow; claws dark brown; soles bright orange-yellow; eyelids in 90 bright orange-red.

The Plaintive Cuckoo is a generally distributed and common species throughout the area. It keeps, usually singly, to gardens, groves and open scrub country near cultivation. Its call of several notes *Peee-pi-pee-peee*, *pi-pee-peee* or just *pi-pee*, *pi-pee* is a familiar sound in Hyderābād gardens and is usually uttered from some exposed part of a tree. When calling, the bird's tail remains depressed, the rump is slightly arched and the wings often droop at the sides.

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The stomach of one contained remains of a grasshopper and many red bugs (Coccinelid?). It sometimes descends to the ground and hops a few steps after insects, and I have also observed one catching red bugs in mid-air after the manner of a flycatcher.

Breeding: The organs of the specimens were in an undeveloped condition. On 23 October (Sanābād) a juvenile was observed being fed and fussed over by a pair of Ashy Wren-Warblers (*Prinia socialis*) (see note). The imposter was fully fledged and able to fly about. The 'cheeps' it uttered when clamouring to be fed were low and feeble such as one would expect from a much smaller bird. While in the act of being fed it uttered a long excited cheeping noise. In Hyderābād City and immediate environs this Cuckoo usually lays in the nests of *Prinia socialis*, while a few miles outside, the Tailor Bird (*Orthotomus sutorius*) is the common fosterer. In both these cases, as shown by the remarkable series collected by Mr. R. K. Burnett, the colouration of its eggs has evolved in such a way as to bring about a close resemblance to those of the fosterers in the two different areas.

Fairbank (S.F., iv, 255) records the Plaintive Cuckoo from Ahmednagar and the Goa Frontier. According to Vidal (Butler, S.F., ix, 388) it is common during the rains in many parts of the south, especially in the forest tracts west of Belgaum as far west as Vengurla, less common northwards. He noticed it at Satāra and considers it rare at Ratnāgiri.

Penthoceryx sonneratii sonneratii Latham. The Indian Bay-banded Cuckoo.

Penthoceryx sonneratii Latham, Index Orn., vol. i (1790), p. 215—India.

Specimen collected: 572 ♂ 18-3-32 Kaulās 1,400 ft.

Elsewhere not noted.

Iris brown; bill horny-black, olive-grey at base of lower mandible; legs and feet greyish-green; claws horny brown.

The above was a solitary bird among overgrown fort ruins, hunting insects in the same manner as the Plaintive Cuckoo. It was silent.

The testes measured ca 4×2 mm. and appeared to be developing.

From neighbouring areas, Fairbank (S.F., iv, 255) records it from Khandāla on the Ghats, and Butler (S.F., ix, 388) from Belgaum.

Clamator jacobinus (Boddaert). The Pied Crested Cuckoo.

Cuculus jacobinus Boddaert, Tabl. Pl. Enlum (1783), p. 53 for Pl. Enl. 872—Coromandel Coast.

Specimens collected: 343 ♀, 344 ♂ 20-11-31 Pāloncha 300 ft. The Sparrow Coll. contains the following: ♂ (ad.) 23-10-10, ♂ (imm.) 5-12-10, ♀ (imm.) 9-12-10, ♀ (ad.) 13-6-11, ♀ (ad.) 15-6-11.

Elsewhere noted at: Hyderābād City and Environs, Manānūr, Borgampād, Khūldābād and Vizāpūr (Aurangābad Dist. 18-31 October 1924).

Last seen 20 November (Pāloncha).

In No. 343: Iris brown; bill horny-black, lemon-yellow at chin; mouth pale yellowish pink; legs and feet slaty-grey; claws black. In 344: gape and basal two-thirds of lower mandible lemon-yellow; mouth: inside both mandibles bright yellow; palate and gullet livid pink.

[The two races depend entirely on measurements. A small series of adults (2 ♂♂ wing 144 mm., 3 ♀♀ wing 145-154 mm.) collected in Hyderābād suggests that they are closer to the small race *taprobanus* than to the larger typical race, and the dates tend to corroborate this. For the present therefore it is advisable to leave the name binomial.—H.W.]

The Pied Crested Cuckoo is probably a rainy season migrant into the Hyderābād State as it is in neighbouring areas. It frequents gardens, groves and the neighbourhood of cultivaion and is usually met with either singly or in pairs. I found it silent on the whole and the birds had probably finished breeding by then. It is fond of hunting among low bushes and scrub close to the ground.

The specimens were a pair, the only ones seen in the locality, and also the last to be met with by the Survey. Their gonads were undeveloped and they were in worn brownish immature plumage although their skulls furnished no indication as regards juvenescence.

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At Kihim in the Kolāba Dist. of North Konkan, where also it is a rainy season immigrant, I observed a pair in copula on 16 August. About this time the birds were busy foisting their eggs on Bombay Babblers (*Turdoides s. somervillei*) and I recovered a fully formed egg from the oviduct of a female shot on 29 August.

Eudynamis scolopaceus scolopaceus (Linn.). The Koel.

Cuculus scolopaceus Linn., Syst. Nat. ed. x (1758), vol. i, p. 111—Bengal.

Specimen collected: 165 ♀ 18-10-31 Farāhābād 2,800 ft.

Elsewhere noted at: Hyderābād City, Āchampet, Manānūr, Borgampād, Mūkhēr, Utnoor, Aurangābād, Bhāmarvādi.

Iris brownish-red; bill pale sea-green, dusky on culmen; legs and feet slaty-blue; claws dusky.

The Koel is generally distributed in the State, but I did not find it really abundant anywhere. Before 19 January it was noted as quite silent but thereafter its crescendo *Koo-oo, koo-oo* etc. was increasingly heard, till about the end of April it was heard on all sides, being also one of the earliest bird voices in the morning. Koels were regularly observed feeding on ripe Peepal and Banyan figs in mixed avian company.

The ovaries of the specimen were in non-breeding condition. Davidson & Wenden (S.F., vii, 79) considered the Koel common in the Deccan in the rains and breeding then. According to Butler (S.F., ix, 389) it is a permanent resident in some of the Deccan districts though locally common throughout the region, especially in Belgaum and Ratnagiri etc. where he found it very abundant. The same writer took eggs in Belgaum from 13 April to 15 May (N. & E., ii, 395-6).

In the neighbourhood of Bombay and about Kihim in the Kolāba district (N. Konkan) the principal laying season seems to be June and July, synchronising with the breeding of the House-Crow (*Corvus splendens*) in whose nests most of the eggs are deposited.

Rhopodytes viridirostris (Jerdon). The Small Green-billed Malkoha.

Zanclostomus viridirostris Jerdon, Madr. Jour. Lit. Sci., vol. xi (1840), p. 223—Coonoor.

Specimens collected: 97 ♂ 11-10-31 Manānūr 2,000 ft.; 359 ♂ 23-11-31 Pāloncha 300 ft.

Elsewhere noted at Borgampād.

Iris dark brown; loose crinkled orbital skin greenish-grey in 97, sky-blue in 359; bill sea-green, paler in 97, richer in 359; palate sea-green, gullet slaty-black; legs and feet olive-slate; claws dusky.

This Cuckoo was met with singly, in scrub and secondary jungle, and usually kept to low bushes and trees.

Breeding: The testes of the specimen were undeveloped. Davidson & Wenden (S.F., vii, 79) who considered it tolerably common in the jungles about Nulwar, took a nest with two eggs there in July.

Other breeding records from neighbourhing areas are as follows: A clutch of two eggs on 10 March near Wandiwash in North Arcot (Cardew); another clutch of two eggs in the granite hills N.-E. of Nulwar station in the middle of July (Wenden) (N. & E., ii, 399).

Butler (S.F., ix, 389) considered this a resident species and not uncommon in the Deccan and Southern Mahratta country. He describes it occurring in the jungles about Belgaum, Ratnagiri and Nulwar.

Taccocua leschenaultii leschenaultii Lesson. The Southern Sirkeer Cuckoo.

Taccocua leschenaultii Lesson, Traite d'Orn. (May 9, 1830), p. 144—L'Inde.

Specimens collected: 592 ♀ 22-3-32, 596 ♂ 23-3-32 Kaulās 1,350 ft. The Sparrow Coll. contains ♀ 22-12-? Trimulgherry.

Elsewhere noted at: Mālegaon (Nander Dist., Mrs. Tasker !), Kandahār, Kannad, Bhāmarvādi, Utnoor.

Iris brown; bill magenta-crimson, yellow at tips of both mandibles and brown on commissure; mouth slaty- or brownish-black; legs and feet horny plumbeous; claws duskier.

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Excepting just once at Utnoor, I met this bird only in the drier portions of the State—the Mahrattwāda. It inhabits open, broken, lightly-wooded or scrub-covered hillsides, and was on the whole shy. Frequently, when followed up, it alights on the ground and escapes by running over the loose stones and dodging round the bushes at great speed, with lowered head and horizontally held tail.

Davidson & Wenden (S.F., vii, 79) recorded this species as common in the Nulwar jungles and also in the bare hills at Satāra. They secured a specimen at Lanaoli in the Ghats. Vidal obtained a few specimens and eggs in Ratnāgiri, and Jerdon procured specimens at Jālna (Butler, S.F., ix, 389).

Breeding: No. 592 (22 March) had the ovarian follicles developed to ca. 3 mm. in diameter, and the testes of No. 596 (23 March) measured 5×3 mm. The birds at this period had paired off and it was apparent that they were preparing to breed. The behaviour of a pair on 23 April (Bhāmarvādi) also suggested that they were breeding.

Centropus sinensis parroti Stresemann.—The Southern Crow-pheasant.

Centropus sinensis parroti Stresemann, Nov. Zool., vol. xx (1913), p. 323—Ceylon.

Specimen collected: 642 ♂ 3-4-32 Utnoor 1,250 ft. The Sparrow Coll. contains: ♀ 10-1-11 Limbgāon, Deccan ♀ 20-2-11 Masaipēt, Deccan.

Elsewhere noted at: Manānūr, Borgampād, Āsifābād, Kandahār, Aurangābād, Bhāmarvādi, Hyderābād City & Environs.

Iris crimson; bill, legs, feet and claws black.

A common species throughout the State, affecting scrub jungle, light deciduous forest and the neighbourhood of cultivation, usually singly or in pairs. Besides the familiar *Ook-ook-ook* call, it has a large variety of harsh croaks and chuckles.

The stomach of the specimen contained one large locust and other unidentifiable insect remains. Its testes were small and gave no indication as regards the breeding season.

Family: Psittacidæ.

Psittacula eupatria eupatria (L.). The Large Indian Paroquet.

Psittacus eupatria Linn., Syst. Nat., ed. x (1766), p. 140—Gingee.

Specimens collected: 129 ♂ 14-10-31 Manānūr 2,000 ft.; 176 ♂ 19-10-31 Farāhābād 2,800 ft.

Elsewhere noted at: Borgampād, Pākhāl Lake, Āsifābād, Kaulās, Utnoor.

Iris lemon-yellow; eyelids orange-yellow; bill scarlet, orange-red at tips and darker on culmen; legs and feet dirty yellow; claws slate.

[The above two males have wings 214 and 215 mm. respectively and the beak is less massive than in *nipalensis*.—H.W.]

The Large Indian Paroquet was commonest on the Amrābād Plateau, a locality which for some obscure reason has become famous popularly for its wonderful variety of parrots! Actually, I found no others besides this and the next two species, none of which happen to be confined to this neighbourhood.

This species keeps in small parties of four to ten birds, and I found it much less destructive to jowari and other crops than the other parakeets. On the Amrābād Plateau it usually kept to the forest and was seldom seen in cultivated country except when flying across from one patch of jungle to another. Its cry is deeper and more 'sedate' than that of the Rose-ringed species.

The testes of the specimens were in non-breeding condition.

Psittacula krameri manillensis (Bechst.). The Rose-ringed Paroquet.

Palæornis manillensis Bechst., Stubenvögel (1794), p. 612—Ceylon.

Specimens collected: 25 ♂ 5-10-31 Manānūr 2,000 ft.

Elsewhere noted at: Singarenni Collieries, Borgampād, Pākhāl Lake, Āsifābād, Kandahār, Mūkhēr, Utnoor, Kaulās, Nirmal, Ellora, Aurangābād, Hyderābād City & Environs.

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Iris greyish-blue; eyelids bright orange; bill scarlet, brownish on commissure and brownish-black on tips; mouth pale flesh pink; legs, feet and claws grey.

This is the commonest paroquet in the Dominions, and one of the most destructive individual bird species to ripening crops. I frequently observed flocks of hundreds in jowari fields. It also does much damage to fruit gardens and has practically no compensating virtues. It is a constant attendant on the blossoms of *Butea frondosa* and *Erythrina indica*, but even here its value as an agent in their cross-pollination is doubtful. Mhowa flowers when in season, also form a substantial part of its dietary. The birds may frequently be seen at wayside railway stations clinging to bags of grain awaiting shipment, biting into them and helping themselves to the contents.

Breeding: The organs of the specimen were in an undeveloped condition. On 26 April, numbers were observed occupying holes in the scarp of rock at the back of Kailāsa Cave at Ellora, but whether they were actually breeding at the time it is difficult to say. On 14 April the same was noted of several birds in holes in buildings in Aurangābād City.

Davidson & Wenden (S.F., vii, 78) who also found it common in the Deccan, say that it breeds in December, January and February. Butler (N. & E., iii, 86) took clutches of 3 and 4 eggs at Belgaum on December 28 and 31 and on February 3 and 23.

Psittacula cyanocephala cyanocephala (L.). The Blossom-headed Paroquet.

Psittacus cyanocephalus Linnaeus, Syst. Nat., ed. xii (176), p. 141, No. 10—India orientale=Gingee.

Specimens collected: 164 ♀ 18-10-31 Farāhābād 2,800 ft.; 467 ♂ 14-12-31 Asifābād 1,200 ft.; 626 ♂ 1-4-32 Utnoor 1,250 ft.

Elsewhere noted at: Manānūr, Borgampād, Pāloncha, Pākhāl Lake, Kannad, Bhāmarvādi.

♂ Iris outer ring cream colour, inner khaki; bill, upper mandible orange with paler tip, lower mandible brownish-black; legs and feet greenish-grey; claws plumbeous. ♀ iris lemon yellow; bill yellow, dusky at sides and tip of lower mandible; legs and feet pale grey; claws dusky; mouth pale fleshy grey.

A generally distributed and fairly common species, though more confined to wooded country. On the Amrābād Plateau it is a scourge to the cultivator and does great damage to ripening jowari crops, being assisted in its ravages by the Rose-ringed Paroquet. I have frequently seen flocks of between two and four hundred birds in this locality.

The flight of these paroquets is very swift, and flocks on the wing turn and twist their way through the stems of trees in the forest with astonishing agility and orderliness, uttering a shrill interrogatory *tooi*? or *tooi-tooi*? This peculiar call and the yellow tail-tip which is conspicuous in flight make their identity unmistakable.

Besides grain, I found their food to consist largely of Ficus figs and the small black drupes of *Zizyphus oenoplia*. Mhowa and *Butea* flowers are also eaten and a specimen shot off the latter had a quantity of pollen adhering to its throat feathers.

This bird appears to be a resident in some parts of its range while in others it is only a seasonal visitor; its status in the Hyderābād State is uncertain. It is said by Davidson & Wenden (S.F., vii, 78) to be an abundant resident in the Satāra District, but in the Sholapoor District to be apparently more of a rains visitor. Fairbank (S.F., iv, 255) also states that it is common along the Sahyādris but visits the Deccan plains in flocks only at some seasons. According to Butler (S.F., ix, 384) most retire to the Ghats to breed. Aitken (N. & E., iii, 88) records its arriving in flocks about the middle of June in Berar, after an absence of several months.

Breeding: The gonads of the specimens were in non-breeding condition, but on 31 March (Utnoor) a pair were observed in courtship, immediately after which the female entered a hole in a dead tree at about 12 feet (deciduous forest) whence she could be dislodged only after much knocking. On 12 April also

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a pair was noted in courtship on the wall of the ruined fort at Nirmal, and the birds appeared to be breeding in one of the numerous holes there.

According to Davidson & Wenden (S.F., vii, 78) it breeds in the plains of the Satāra District in December and on the Ghats in March.

Family: Coracidæ.

Coracias benghalensis indica Linn. The Indian Roller.

Coracias indica Linn., Syst. Nat., ed. xii, vol. i (1766), p. 159—Ceylon.

Specimens collected: 367 ♂, 368 ♂ 24-11-31 Pāloncha 300 ft. The Sparrow Coll. contains ♂ 1-11-10, ♂ 25-11-10, ♂ 16-1-13 Trimulgherry.

Elsewhere noted at: Hyderābād City Environs, Manānūr, Kāzipēt, Borgampād, Nelipāka, Āsifābād, Kandahār, Utnoor, Aurangābād.

Iris pale brown; eyelids dull orange; bill brownish-black; mouth sulphur yellow and pink; legs and feet dirty brownish-yellow; claws black.

[The Survey specimens as well as those in Col. Sparrow's collection and an unsexed Hyderābād specimen of Gould's in the British Museum are indistinguishable in colour from the Ceylon race and also agree in measurements with the Ceylon bird.—H. W.]

The Roller is a common and familiar bird (resident?) of cultivated and open country throughout the State. At Utnoor (April) it was found to be abundant in the leafless deciduous forest, the attraction no doubt being the suitable nesting sites afforded by holes in the dry trees. The birds as a rule are met with singly or in pairs, perched on posts, stakes or hedges near fields, whence they descend to the ground now and again to pick up an insect, returning with the morsel to the same perch or flying lazily across to another in the vicinity. Like the Drongo, they appear to be wholly beneficial to agriculture, and their destruction for the sake of their showy plumes (which I unfortunately often observed) should be severely penalised.

Breeding: The testes of the specimens were in a quiescent state. By the beginning of March courtship displays had become common. In these, the male usually rises perpendicularly to some height in the air to the accompaniment of hoarse cries, and describes a series of wave-crests, his glorious plumage flashing in the sun. The axis of the body, held vertical till the crest is reached is thereupon suddenly reversed so that the bill which was formerly pointing skywards now points to the ground. In this manner the bird shoots down with closed wings about the same distance he had mounted, and after a few repetitions of this stunt returns to his perch on the top of some tree or other exposed situation. Much the same sort of display is indulged in by the Black-bellied Finch-Lark also.

From about this time on, pairs were observed appropriating suitable holes in dry trees as nesting sites and chasing off kites, crows and other birds that transgressed into their territories, with loud raucous screams and much bluster. Between 1 and 10 April, it was commonly found to be breeding in holes in trees in the deciduous forest about Utnoor.

Aitken (N. & E., iii, 54) found it very common in Berār and also nesting there in May, and in the face of the evidence we have it is difficult to understand the statement of Davidson & Wenden (S.F., vii, 77) that it does not breed in the 'Deccan' (by which presumably they meant the Bhima Valley).

Family: Meropidæ.

Merops orientalis orientalis Latham. The Common Indian Bee-eater.

Merops orientalis Latham, Ind. Orn. Suppl. (1801), pl. xxxiii—Mahratta Country.

Specimens collected: 634 ♂ 2-4-32 Utnoor 1,250 ft.; 701 ♂ 16-4-32 Kannad 2,000 ft.

Elsewhere noted at: Hyderābād City & Environs, Manānūr, Singarenni Collieries, Borgampād, Narsampēt, Āsifābād, Kandahār, Kaulās, Aurangābād, Nirmal and Bhāmarvādi. Also at Mālegaon (Nander Dist.) and Khūlābād (Aurangābād Dist.) by Mrs. Tasker.

Iris scarlet or brownish-crimson; bill brownish-black; mouth pink; legs and feet yellowish-brown; claws horny brown.

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The status of this bird in Hyderābād seems to be partly resident and partly winter visitor. Although some numbers remain the whole year round and breed, a marked influx from outside was noted from the end of September and in the first half of October. From this time on, upto the end of February or thereabouts, the Bee-eater was very common all over the country. Thereafter there was again a noticeable diminution in their numbers and what remained behind had mostly paired off.

Large numbers assemble to roost in the evenings on selected trees, and much noise and bustle prevails before the birds finally retire for the night. Every now and again the whole concourse rises in the air and after circling round in a confused rabble to the accompaniment of much 'trilling' the birds gradually settle down once more. These manoeuvres are repeated several times before quiet is restored. They are late risers and may frequently be seen huddled together in groups on the branches of a tree with their heads tucked away under their wings and fast asleep till after the sun is well up. I frequently observed them capturing and eating dragonflies.

Davidson & Wenden (S.F., vii, 77) found this species common and breeding in the Deccan. According to Aitken (N. & E., iii, 61) they disappear in the hot weather from Poona, which I have also noticed to be the case with the large majority of Bee-eaters in and around Bombay.

Breeding: The testes of both the specimens (2 and 16 April) appeared to be developing. They measured ca. 5×3 mm. On 21 April a pair had cheeping young in the side of a pit in the D.S.P.'s garden near the Aurangābād Jail. Other birds, from their behaviour, also appeared to be breeding about this time.

Merops superciliosus javanicus Horsf. The Blue-tailed Bee-eater.

Merops javanicus Horsf., Trans. Linn. Soc. vol. xiii, pt. i (May 1821), p. 171—Java.

No specimen obtained.

I am unable to say whether this bird is just a passage migrant over Hyderābād State or whether some birds actually winter in this area. In the course of the Survey I only came across a small party of 3 or 4 birds at the foot of the Amrābād Ghāt on 4 October. The only other record I have for the area is a flock of about 12 birds seen at Saifābād (Hyderābād City) between 5 and 11 October, 1925.

Davidson got a young specimen near Pundharpūr in October and states (S.F., vii, 77) that they are not common in the Deccan (Bhima Valley) and appear only in the cold season. Fairbank (S.F., iv, 254) seems to have met with it only once at Ahmednagar.

The flight of the Blue-tailed Bee-eater seems much swifter and the swoops more graceful than those of the smaller species, while its call notes are lower in key and easily distinguishable from those of the Common Bee-eater, but very similar to those of the next species.

Melittophagus erythrocephalus erythrocephalus (Gmel.). The Chestnut-headed Bee-eater.

Merops erythrocephalus Gmelin, Syst. Nat., vol. i, pt. i (1788), p. 463—India orientale.

Specimens collected: 277 ♀ 9-11-31, 337 ♀ 17-11-31 Nelipāka 160 ft.

Elsewhere noted at: Pāloncha Hill, Pākhāl Lake.

Iris brownish-orange or scarlet; bill black; mouth pink; legs and feet brownish-slate; claws black.

Small flocks of the Chestnut-headed Bee-eater, usually of 4-8 birds, were seen in forest in the above localities, launching graceful sallies after winged insects and circling back to their perches on the bare upper branches of forest trees. I found their call notes indistinguishable from those of the Blue-tailed species.

The ovaries of the specimens showed no departure from the normal non-breeding condition.

Fairbank (S.F., iv, 254) met with this Bee-eater on the sides and bases of the Goa and Sāvantvādi Hills, and Butler (S.F., ix, 382) noticed it on the Amboli Ghāt west of Belgaum.

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Family: Alcedinidæ.

Ceryle rudis leucomelanura Reichenbach. The Indian Pied Kingfisher.

Ceryle leucomelanura Reichenbach, Handb. Alced. (1851), p. 21—Ceylon.

Specimen collected: 528 ♂ 9-3-32 Mūkhēr 1,350 ft.

Elsewhere noted at: Hyderābād City and Environs, Kāzipet, Dornākal, Borgampād, Narsampēt, Āsifābād, Kandahār.

Iris brown; bill, legs, feet and claws horny-black; mouth pale yellowish-pink.

A common resident species, almost invariably present about tanks and streams, usually in pairs. The hovering, which is such a spectacular habit of this Kingfisher, is invariably done against the wind, the bird taking full advantage of the resistance. Occasionally the bird has to wheel right round to do this.

Breeding: The testes of the specimen were undeveloped, but on 22 March a nest was dug up in the bank of a stream at Kaulās, about 12 inches above water level, with a tunnel about 3 feet long. It contained 4 newly-hatched chicks and one cracked egg. Inspite of the excavation, the parents continued to feed the young. A fresh fish, one inch long, was found in the nest.

Davidson & Wenden (S.F., vii, 77) found this Kingfisher common in the Deccan (Bhima Valley) and apparently breeding at all seasons except the very hot months. Aitken (N. & E., iii, 10) took a clutch of 6 eggs at Akola (Berār) at the end of January or the beginning of February.

Alcedo atthis bengalensis Gmelin. The Common Indian Kingfisher.

Alcedo bengalensis Gmelin, Syst. Nat., vol. i, pt. i (1788), p. 450—Bengal.

Specimens collected: 518 ♀ 7-3-32 Mūkhēr 1,350 ft.; 662 ♀ 6-4-32 Utnoor 1,250 ft.

Elsewhere noted at: Nelipāka, Dornākal, Pākhāl Lake, Āsifābād, Kandahār, Nirmal, Kannad.

Iris brown; bill, upper mandible brown, gape and lower mandible bright orange; mouth orange-brick; legs and feet like lower mandible but brighter; claws dusky.

This little Kingfisher is a resident species and commonly found in the neighbourhood of streams, pools, flooded borrow-pits and even wells. It is usually solitary except in the breeding season when pairs is the rule. I definitely failed to meet with it at Manānūr and Farāhābād.

Breeding: No. 518 (7 March) had the ovaries in a quiescent state, while in 662 (6 April) the follicles measured ca. 1 mm. in diameter, and were apparently maturing. On 12 April (Nīrmal) a brood of 4 fully-fledged chicks was observed at a roadside pool being tended by one of the parents who brought them small fish. The bill, legs and feet of the young were horny-brown, the latter tinged with red.

Davidson & Wenden (S.F., vii, 77) found this species fairly common and breeding in the Bhīma Valley. They took a nest at Satāra in June. Bruce took clutches of 5 and 6 eggs respectively on 15 March at Rahuri (Ahmednagar) and Butler a clutch of 4 hard-set eggs on 22 August and another of 7 eggs on 3 September (N. & E., iii, 2-3).

Ramphalcyon capensis (Linn.) ssp.?. The Brown-headed Stork-billed Kingfisher.

Alcedo capensis Linn., Syst. Nat., ed. xii, vol. i (1766), p. 180—Cape of Good Hope *in errore*=Java.

No specimens obtained.

Noted at Pākhāl Lake, Āsifābād and Utnoor.

This large kingfisher is entirely a forest species, keeping to heavily shaded and overgrown forest streams either singly or in widely separated pairs. Its chattering call or 'laugh'—*ke-ke-ke-ke-ke-ke* is somewhat like that of the White-breasted species but louder and more raucous. I have an unconfirmed note that one was heard at Saifābād on 19 and 20 January.

Fairbank (S.F., iv, 254) found it once near Mahābleshwar and Mr. Laird (S.F., ix, 382) obtained it in the forests west of Belgaum.

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Halcyon smyrnensis (Linn.) subspecies? The White-breasted Kingfisher.

Alcedo smyrnensis Linn., Syst. Nat., ed. x, vol. i (1758), p. 116—Africa and Asia.

No specimens obtained.

A common, familiar and generally distributed species met with both near and away from water in deciduous forest, scrub country and cultivation. Its food seems to consist more of insects than of fishes and frogs. On one occasion I saw it carry off a day-old chick of the Red-wattled Lapwing.

Davidson & Wenden (S.F., vii, 77) describe it as very abundant in the Deccan (Bhima Valley) and breeding there in March and April. Fairbank (S.F., iv, 254) and Butler (S.F., ix, 382) also found it common and generally distributed and a resident everywhere.

In the neighbourhood of Bombay (N. Konkan) I have taken eggs in the first half of May.

Family: Bucerotidæ.

Hydrocissa malabaricus (Gmelin). The Malabar Pied Hornbill.

Buceros malabaricus Gmelin, Syst. Nat., vol. i (1788), p. 359—Malabar.

No specimens obtained.

I came across this Hornbill only at Borgampād in the Godāvari Forest Belt on the extreme eastern boundary of the State. A flock of 6 birds was met three days in succession in a patch of riverain jungle on the banks of the Kinārsāni River. They were extremely wary and kept to the tops of the loftiest trees, feeding on a species of *Ficus* figs. Their loud harsh call was also once heard subsequently at Nelipāka (10 November).

Tockus birostris (Scopoli). The Common Grey Hornbill. Telugu: *Supanāti.*

Buceros birostris Scopoli, Del. Flor. et. Faun. Insubr., vol. ii (1786), p. 87—Coromandel.

Specimen collected: 551 ♂ 15-3-32 Deglūr 1,300 ft.

Elsewhere noted at: Manānūr, Farāhābād, Borgampād, Pāloncha, Mūkher, Utnoor, Aurangābād, Kannad, Bhāmarvādi.

Iris bright brownish-orange; bill slaty-black on basal portion including casque, creamy-white on culmen, tips and most of lower mandible; mouth: palate pale yellowish-flesh, gullet dark slate; legs and feet slaty-black; claws black.

A commonly distributed species usually met with in pairs or small parties in light deciduous forest or open country about villages and cultivation, wherever there is a sprinkling of *Ficus* trees in fruit. Among a mixed gathering of birds feeding on ripe Banyan figs near Manānūr village, as many as thirty of these Hornbills were counted. It has a shrill alarm whistle '*wheee*' by which the assembly is apprised of the approach of danger. It soon breaks up into small parties which fly off in different directions in follow-my-leader fashion. The flight, typical of the hornbills, consists of a few laboured wing beats followed by intervals of sailing.

The stomach of the specimen contained Banyan figs (*Ficus bengalensis*) exclusively.

Breeding: The testes of the specimen were enlarged to 16×10 mm. and the bird was evidently preparing to breed. I presume that it was not actually breeding at that date from the fact that it was one of a party moving about in a mango grove near Deglūr town.

A single male was seen in a grove of large mango trees at Kannad (16 April) from whose behaviour it appeared that he might have his mate on a nest in the neighbourhood.

Davidson & Wenden (S.F., vii, 78) record it as moderately numerous in suitable places in the Deccan i.e. principally the Bhima Valley.

Family: Upupidæ.

Upupa epops ceylonensis Reichenbach. The Ceylon Hoopoe.

Upupa ceylonensis Reichenbach, Handb. spec. Orn., Scans. (1853), p. 320.—Ceylon.

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Upupa epops orientalis Stuart Baker. The Indian Hoopoe.

Upupa epops orientalis Stuart Baker, Bull. B.O.C., xlii (29 November 1921), p. 29—India.

Specimens collected: 124 ♀ 13-10-31 Manānūr 2,000 ft.; 350 ♂, 351 ♂ 21-11-31 Pāloncha 300 ft.; 576 ? (imm.) 19-3-32 Kaulās 1,350 ft.; 702 ♀ (imm.) 16-4-32 Kannad 2,000 ft.

Elsewhere noted at: Hyderābād City & Environs, Kandahār, Mūkhēr, Utnoor, Nīrmal.

Iris brown; bill horny-brown or horny-black, paler (flesh colour) at gape and base of lower mandible; mouth pale flesh; legs and feet greyish- or slaty-brown.

[Nos. 124, 576 and 702 belong to the small dark resident form *ceylonensis* without the white at the end of the crest. Nos. 350 and 351 are of the north Indian form *orientalis*, evidently a winter visitor to Hyderābād. This probably is the *epops* of some records.—H.W.]

The Hoopoe affects open country in the neighbourhood of cultivation and villages as well as scrub jungle and light deciduous forest. It is usually met with in pairs which are often much separated when feeding on the ground. It probes amongst fallen leaves and in the earth with the bill partly open like a pair of forceps. The crest is erected and opened out fanwise upon alighting after every short flight. It runs about on the ground on its short legs with a quail-like but somewhat waddling gait, at times quite fast.

Breeding: About the beginning of March, I noticed that the males had begun calling their distinctive *Hoo-po* or *Hoo-po-po* etc. on every side. While uttering this, the head jerks forward as if the bird was barking, and the crest is erected and depressed from time to time. No. 576 (19 March) was a juvenile with imperfectly ossified skull, while 702 (16 April) was slightly older having the unossified portion confined only to the centre of the skull.

According to Burgess (N. & E., ii, 335) the Hoopoe (presumably *U. e. ceylonensis*) breeds in the Deccan in the middle of April and in May. Butler (N .& E., ii, 336) took a nest with young on 31 March at Belgaum.

Family: Trogonidæ.

Harpactes fasciatus (Pennant) subspecies? The (Malabar?) Trogon.

Trogon fasciatus Pennant, Ind. Zool. (1769), pl. iv—Ceylon.

No specimen obtained.

On 12 October (1931) in mixed bamboo jungle on the hillside leading up to Mahēswara Plateau (Amrābād) I caught a fleeting glimpse of a bird that almost certainly was this Trogon. This was the only occasion when I came across the species in Hyderābād State. It was unfortunately not possible to secure the specimen, but it doubtless belonged to the form *malabaricus* of Gould.

Regarding the distribution of this bird in the Southern Mahratta Country Butler (S.F., ix, 381) states that it is resident, occurring sparingly in most of the well-wooded tracts along the Sahyadris and in the forest tract west of Belgaum; that it is not uncommon in Kanara and that Fairbank obtained it in the woods of Sāvantvādi and at the base of the Goa Hills.

Bingham (N. & E., ii, 341) took a nest with eggs about the middle of May on the Rām Ghat between Belgaum and Vingorla.

Family: Micropidæ.

Micropus melba (Linn.) ssp? The Alpine Swift.

Hirundo melba Linn., Syst. Nat., ed. x, vol. i (Jan. 1758), p. 192—Gibraltar.

No specimen obtained.

Several of these magnificent birds were constantly observed flying about the escarpment and hills at Outram Ghāt (Bhāmarvādi) 2,500 ft., overlooking Chālisgaon and the Khāndesh Plains (18-24 April).

Davidson & Wenden (S.F., vii, 77) described it as a permanent resident in Satāra, and Davidson thought that it bred about the cliffs and on old buildings in the fort there. As far as I know this has never been confirmed.

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Butler (S.F., ix, 379) records it only as a cold weather visitor to Deccan and the Southern Mahratta Country being common all along the Ghats where it roosts, going by day to feed over the plains.

McMaster (N. & E., iii, 21) is said to have observed several swifts, apparently this species, at Gawilgarh and Chiklada (Berar) at ca. 3,700 ft. in April and May which appeared to be breeding on the cliffs. This also lacks confirmation.

Micropus affinis affinis (Gray). The Common Indian Swift.

Cypselus affinis Gray, Illustr. Ind. Zool., vol. i (March 1830), pl. 35, fig. 2 —Bengal as known to the E. I. Co.

Specimen collected: 517 ♂ 7-3-32 Mūkhēr 1,350 ft.

Elsewhere noted at: Hyderābād City & Environs, Manānūr, Kandahār, Kāmāreddi Railway Station, Kannad, Ellorā Caves, Khūldābād (Aurangābād Dist.).

Iris brown; bill horny-black; mouth pink; legs and feet pinky brown; claws horny-black.

The Common Swift is a familiar bird in Hyderābād City and in most other towns in the Dominions. It is invariably to be met wherever old forts, mosques, bridges and buildings with porticos are present to furnish suitable nesting sites. Large disorderly gatherings may frequently be seen in the evenings wheeling round high up in the air uttering their shrill joyous 'screams' and quite obviously sporting themselves.

Breeding: On 10 October a pair commenced building under the ceiling of the Dak Bungalow verandah at Manānūr, but deserted after 2 or 3 days. On 10 February I observed many nests being built under eaves etc. of the Osmānia General Hospital in Hyderābād City. The testes of the specimen (7 March) measured ca. 7×4 mm. and suggested breeding, although curiously enough as in the case of *Passer domesticus* recorded above, the skull clearly indicated by two soft patches in the centre that the bird was not yet fully adult.

Davidson & Wenden (S.F., vii, 77) found it common everywhere in the Deccan (Bhima Valley) and about Ahmednagar; also Fairbank (S.F., iv, 254) recorded it as abundant. On the other hand Jerdon (B. of I., i, 178) writes: 'I on one occasion traversed the whole tableland of Southern India from the Taipoor Pass near Jaulnah to Salem and only saw it twice and then in small numbers.'

Cypsiurus batasiensis palmarum (Gray). The Palm Swift.

Cypselus palmarum Gray in Hardwicke's Illustr. Ind. Zool., vol. i (1832), pl. 35, figs. 1a and 1b—Cawnpore.

Specimens collected: 247 ♂ 5-11-31 Borgampād 160 ft.; 681 ? (juv.), 682 ♂ 9-4-32 Utnoor 1,250 ft.

Elsewhere noted at: Hyderābād City & Environs, Malkāpūr, Nekonda, Narsampēt, Kaulās, Aurangābād.

Iris dark brown; bill black; legs and feet dark blackish-brown.

The distribution of this little swift in the State is inseparably linked with the occurrence of *Tad* palms (*Borassus flabellifer*). It is found where the palms are found and is absent where they are absent; thus at Manānūr and Farāhābād the absence of both was conspicuous. The precise factor (or factors) in this biotic relationship needs to be determined, but the rigid folds and furrows of the palm leaf provide admirable roosting and nesting sites for the birds. Along the road from Nekonda Railway Station to Narsampēt, the *Tad* palm increases in abundance after Amīnābād until in the vicinity of Narsampēt it may be counted by the hundred thousand. With the palms a corresponding increase in the numbers of palm swifts is immediately noticeable.

Breeding: The testes of No. 247 (5 November) were in non-breeding condition. By about March-April the breeding season appeared to be in progress. No. 681 (9 April) was juvenile with a very soft skull, while No. 682 had the testes enlarged to 6×4 mm. and the bird was in general (post-nuptial?) moult.

According to Davidson & Wenden (S.F., vii, 77) the Palm Swift is very rare in the drier portions of the Deccan. It is tolerably numerous in the palm groves near Nulwar. Davidson saw 3 amongst some small palms about 5 miles from Akulkote. Fairbank (S.F., iv, 254) found them common in the

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vicinity of Ahmednagar and Butler (S.F., ix, 380) in Poona. Aitken (N. & E., iii, 26) notes that in Berar palm trees are scarce, but that wherever there is one this bird will be found. He saw it once round a grove of mangoes, miles from any palm.

Hemiprocne coronata (Tickell). The Indian Crested Swift.

Hirundo coronata Tickell, J.A.S.B., vol. ii (November 1833), p. 580—Borabhum.

Specimens collected: 433 ♂ 7-12-31 Pākhāl Lake 800 ft.; 637 ♂, 638 ♀ 3-4-32 Utnoor 1,250 ft.

Elsewhere noted at: Sirkonda (en route Itchora-Utnoor), Narsampēt.

Iris brown; bill black; mouth pinkish-grey; legs and feet purplish-brown; claws brown.

Besides the above localities, this species was not met with by the Survey. It was commoner at Utnoor than elsewhere, though by no means abundant. The Crested Swift keeps to open deciduous forest. Its flight is very similar to that of the Palm Swift from which, however, it is immediately distinguishable by its larger size and the longer and more deeply forked tail. It utters a harsh *chuck-chuck* or *tichuck-tichuck* from time to time, like *Artamus*, and perches freely like a swallow on the bare higher branches of forest trees.

Breeding: The testes of No. 433 (7 December) were undeveloped but both 637 and 638 (3 April) were certainly breeding. The male had the testes enlarged to 5×3 mm. and it had an incubation patch on the abdomen. Some of the ovarian follicles of the female measured 2.5 mm. in diameter.

On 6 April a pair was observed building on the bare twig of a leafless Salai tree (*Boswellia serrata*) at about 40 feet in open deciduous forest bordering a nullah at Arti-Margoo (near Utnoor). The tiny cup looked like a knot in the branch from below. Both birds were working at the structure. The strands of saliva used in the agglutination process were clearly visible gleaming in the sunlight.

Both Fairbanks (S.F., iv, 254) and Butler (S. F., ix, 380) observed the Crested Swift at Khandāla and along the Ghāts. Thompson (N. & E., iii, 37) found a nest with one egg in the Ahiri forests of Chānda (Central Provinces) on 7 May.

Family: Caprimulgidæ.

Caprimulgus indicus indicus Latham. The Indian Jungle Nightjar.

Caprimulgus indicus Latham, Index Orn., vol. ii (1790), p. 588—India.

Specimens collected: 728 ♂ 21-4-32, 746 ♀ 25-4-32 Kannad 2,500 ft. The Sparrow Coll. contains ♀ 1-11-10 Trimulgherry.

Iris dark brown; eyelids dull yellow; bill brownish-black, paler at gape; mouth greyish-pink; legs and feet fleshy- or pinkish-brown; claws black.

A common species chiefly frequenting deciduous forest; flitting about at dusk among the trunks of trees, deftly turning and twisting on the wing as it hawks beetles and other insects. The call is usually uttered from the branch of a tree on which the bird crouches lengthwise. The notes I have likened to water dripping on water (but much louder) at the rate of about 2 drips a second, connected as it were by the echo of the dripping: *chuck-ko, chuck-ko, chuck-ko* and so on.

Breeding: The birds appeared to be breeding in April. Specimen No. 728 (21 April) had the testes enlarged to 7×5 mm. while some of the ovarian follicles of the female measured about 1.5 mm. in diameter. Col. Sparrow's shikari collected the following eggs for him (presumably of this species) at Eswantaraopet, about 25 miles N.-W. of Trimulgherry in thin jungle: C/2 19-4-14, C/1 27-4-14, C/2 6-5-14, C/1 24-5-14.

Caprimulgus monticolus monticolus Franklin. Franklin's Nightjar.

Caprimulgus monticolus Franklin, P.Z.S. 1830-1831 (Oct. 25, 1831), p. 116—Between Calcutta and Benares and in the Vindhyan Hills between the latter place and Gurra Mundela,

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Specimens collected: 297 ♀ 13-11-31, 324 ♀ 16-11-31 Nelipāka 160 ft.; 631 ♀ 2-4-32, 665 ♂ 7-4-32 Utnoor 1,250 ft. Col. Sparrow's collection contains ♂ 2-1-11 Ditchpalli, ♀ 16-12-10 Wadiarum.

Iris dark brown; eyelids dull yellow; bill brownish-black, paler at gape; mouth greyish-pink; legs and feet fleshy-brown; claws black. The gape of No. 297 measured 30 mm. across.

This Nightjar inhabits scrub and deciduous jungle. At Nelipāka it was commonly observed hawking insects over the grassy mudbanks bordering the Godāvari River, while at Utnoor dry beds of forest streams with pools here and there invariably attracted these birds. It is largely crepuscular in its habits and is usually heard either between sundown and dark or sometimes a little later, and again at early dawn. The loud penetrating call of a single note, *sweesh* is uttered chiefly on the wing.

Breeding: The organs of Nos. 297 and 324 shot in November showed no departure from the normal quiescent condition, but the April birds were breeding. No. 631 (2 April) had the ovarian follicles measuring ca. 1.5 mm. in diameter. It was shot off one hard-set egg lying on a bare burnt patch of ground in deciduous forest. When the body was pressed a quantity of clear viscid fluid like the white of an egg exuded from the vent. The bird was very fat about the rump. There was no depression or lining to mark the nest and no shelter of any kind. The bird skulked off a couple of yards on our approach. The egg was of a shade of salmon in ground colour with blotches and mottling of reddish-brown bearing a remarkable resemblance to the pieces of red marble-like gravel with which the ground here was strewn. It measured 29×22 mm.

The testes of No. 665 (7 April) were enlarged to 11×5 mm.

Col. Sparrow's collector obtained the following eggs for him (unconfirmed by skin of parent !): C/2 (fresh) 23-7-12 Trimulgherry, C/2 30-7-12, C/2 15-3-13 Eswantarāopet. Col. Sparrow himself found the following in the Central Provinces: C/2 (fresh) 3-5-12 Muthpalli, C/2 (hatching) 20-5-12 Indravati River. From the above dates it appears that the breeding season is a prolonged one.

Caprimulgus asiaticus Latham. The Common Indian Nightjar.

Caprimulgus asiaticus Latham, Index Orn., vol. ii (1790), p. 588—India, restricted to Bombay (J.B.N.H.S., xxviii, p. 323).

Specimens collected: 100 ♀, 101 ♀, 102 ♂ 12-10-31 Manānūr 2,000 ft.: 523 ♂ 8-3-32 Mūkhēr 1,350 ft.; 582 ♂, 583 ♂ 21-3-32 Kaulās 1,350 ft. Col. Sparrow's coll. contains ♀ 12-12-12 Trimulgherry.

Elsewhere noted at: Hyderābād City & Environs, Borgampād, Kandahār.

Iris brown; eyelids pale yellow; bill horny-brown, paler and pinkish at gape and base of lower mandible; legs and feet brownish-pink; claws dusky.

The commonest Nightjar in the Dominions, being found everywhere about cultivation and in open scrub and boulder country. Its familiar '*chuck-chuck-chuck-chuck-r-r-r*' notes are amongst the commonest bird voices at dusk. These are usually uttered from a perch on a stake, stone or similar situation. The birds are very fond of squatting on roads after dusk and are adept at dodging clear of an oncoming car when it is almost upon them. One of the specimens had a hard-shelled black beetle in its bill.

The first 3 specimens were undergoing a complete moult and their organs were in the normal non-breeding condition. In the birds procured in March a slight development of the gonads was noticeable, but they did not appear to be breeding.

Col. Sparrow's collector obtained 11 clutches of one or two eggs each in thin jungle at Eswantarāopet between 19 April and 7 July.

Family: Tytonidæ.

Tyto alba (Scopoli) ssp.? The Barn Owl.

Strix alba Scopoli, Annus I, Hist. Nat. (1769), p. 21—Friuli in N. Italy.

No specimens obtained.

Noted in the ruins of the fort and about an old temple near Kaulās village between 18 and 23 March (1932). Also at Talamadri village ca. 15 miles from Utnoor, on 14 October (1925). The bird is probably much commoner than these records suggest.

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Family: Asionidæ.

Asio flammeus (flammeus?) Pontoppidan. The Short-eared Owl.

Strix flammea Pontoppidan, Danske Atlas, vol. i (1763), p. 617, pl. xxv.—Denmark.

Not met with by the Survey.

Col. Sparrow shot a ♂ at Pārtūr on 31-1-11.

Strix ocellata (Lesson). The Mottled Wood-Owl.

Syrnium ocellatum Lesson, Rev. Zool. (Oct.-Nov. 1839), p. 289—Pondicherry.

Specimens collected: 414 ♂, 415 ♀ 3-12-31 Narsampēt 800 ft.; 643 ♀ (imm.) 4-4-32 Utnoor 1,250 ft.

Elsewhere noted: Kaulās.

Iris orange-brown; eyelids dull coral red; bill blackish plumbeous, paler at tip; mouth pale yellowish-pink; feet dirty yellowish-brown; soles yellow. In immature (No. 643) feet greenish-grey.

The Mottled Wood-Owl is a dweller of forest, where old Banyan trees are a favourite daytime resort. It is usually met with in pairs but after the breeding season family parties of parents with one or two young were seen. At Kaulās it was partial to the ancient Tamarind groves between the village and the ruined fort. Its call, most commonly heard at dusk and at dawn, is a deep eerie quavering *Chu-hooaa*.

Besides this it has a mellow monosyllabic hoot which is more commonly uttered.

Breeding: The pair shot on 3 December appeared ready to breed. The testes of the male were enlarged to ca. 14×8 mm. while the largest follicles in the ovaries of the female measured 4 mm. in diameter. Specimen No. 643 was juvenile with soft skull and its rectrices and contour feathers were growing. From the above it is evident that in Hyderābād this owl breeds between December and February or thereabouts. Col. Sparrow's Coll. contains the following eggs: C/2 31-12-13 Navipet, C/1 7-3-14, C/1 1-4-14 Eswantarāopet.

Ketupa zeylonensis Gmelin. ssp.? The Fish-Owl.

Strix zeylonensis Gmelin, Syst. Nat., vol. i, pt. i (1788), p. 287—Ceylon.

Not met with by the Survey. Col. Sparrow has a record of a pair at Muiloorpet on 28-1-14 and two fledged young at Eswantarāopet on 14-3-13. He also took a fresh egg at the latter place on 28-1-14.

Bubo bubo bengalensis (Franklin). The Indian Great Horned Owl.

Otus bengalensis Franklin, P.Z.S. 1830-1831 (Oct. 25, 1831), p. 115—Between Calcutta and Benares and in the Vindhyan Hills between the latter place and Gurra Mundela.

Specimens collected: 184 ♂ 29-10-31 Borgampād 160 ft.; 538 ♀ 12-3-32 Deglūr 1,300 ft.; 584 ♀ 21-3-32 Kaulās 1,350 ft.

Elsewhere noted at: Nelipāka, Kannad, Bhāmarvādi.

Iris bright orange-yellow; bill horny black; mouth pink; toes dirty greyish-white; claws horny-black.

This owl frequents well-wooded and boulder hillock country and is partial to mango and tamarind groves. At Borgampād and Nelipāka its favourite resort was among the thick bushes of *Vitex negundo* bordering the steep, deeply outscoured banks of the Godāvari River. They emerged soon after sunset with their deep resounding calls of *Bu-bo* (2nd syllable much prolonged) which while not really loud have the quality of carrying long distances. A small colony of these birds inhabited the rocks of the Pātalganga Gorge at Deglūr. They were shy and flew about in broad sunlight with little apparent discomfort.

The stomachs of the specimens all contained field rats and mice, besides in one case a large earthworm. I also had occasion to examine the pellets disgorged by the birds which were freely strewn about the rocks and found them in every case to consist chiefly of the fur, skulls and other skeletal remains of field rats and mice, while in many cases the pellets were composed exclusively of these. The Horned Owls are a constant natural check on these vermin and therefore obviously of great economic value to agriculture.

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Breeding: No satisfactory evidence as regards breeding was obtained by the Survey beyond the fact that specimen No. 584 (21 March) had some of the ovarian follicles measuring 1 mm. in diameter. The gonads of the other two specimens were in an undeveloped condition.

Col. Sparrow took a clutch of 4 eggs at Eswantarāopet on 5-11-14, and found large young at Masaipet on 5 January.

Otus bakkamœna Pennant. subsp.? The Collared Scops Owl.

Otus bakkamoena Pennant, Ind. Zool., vol. i (1769), p. 3—pl. iii—Ceylon.

Specimens collected: 138 ♀, 140 ♂ 16-10-31 Farāhābād 2,800 ft.

Not noted elsewhere.

Iris brownish-orange; feet dusky lemon-yellow or dusky flesh-colour; claws same but duskier at tips; cere greenish lemon-yellow; upper mandible horny-brown, lower mandible pale flesh colour; commissure brownish.

[These two Scops Owls belong without any doubt to the group of the Collared Scops Owls *Otus bakkamoena* Pennant and the wing formula (2=6/7 in no. 138 and 2=7/8 in no. 140) agrees with this attribution. This group was very thoroughly revised by Ticehurst in 1923 (Ibis 1923, p. 239). The two birds, whilst obviously belonging to the same form are not alike. The female no. 138, wing 146 mm., is a warm fulvous brown in colouration, whereas the male no. 140, wing 144 mm., is of a grey phase. I have carefully compared them at the British Museum. They are certainly not referable to the dark typical race (Ceylon), with which they agree in size, as they are far paler. On the other hand they are definitely too small to refer to *O. b. marathae*. The probability is that they represent an intermediate E. ghats race—for what is Farāhābād expect a slice of the E. ghats contained in Hyderābād State? This is I suspect the form which Jerdon described under his *Scops griseus* Madras Jour. Lit. Sci., xiii, pt. 2, p. 119. I do not think however it would be wise to attempt to set up a new and intermediate race of this highly variable group on two specimens only, more especially when those two specimens vary *inter se*. I should therefore record these specimens binomially until such time as a proper series is available from this or other neighbouring areas of the E. ghats. Unfortunately no Scops Owls were obtained by the Vernay Survey.—H.W.]

Met with in pairs, not uncommonly, in mixed Bamboo forest at Farāhābād.

The gonads of the specimens were in an undeveloped condition.

Col. Sparrow's collector obtained 2 clutches for him (not supported by specimen of parent!) of 4 and 3 eggs respectively on 21 February and 2 April (the latter hard-set) at Eswantarāopet.

Athene brama brama (Temm.). The Spotted Owlet.

Strix brama Temm., Planch. Color d'Ois. (1823), livr. 12, pl. 68—Pondicherry.

Specimens collected: 89 ♀ 11-10-31 Manānūr 2,000 ft.; 331 ♂, 332 ♀ Nelipāka 160 ft.

Elsewhere noted at: Singarenni Collieries, Narsampēt, Kandahār, Kaulās, Utnoor, Nīrmal, Aurangābād, Hyderābād City & Environs.

Iris bright lemon-yellow; bill yellowish grey-green; legs and feet dirty lemon-yellow; claws horny-black.

The Spotted Owlet is the commonest representative of the family in the Hyderābād State. It is found in the neighbourhood of villages and cultivation wherever ancient and gnarled tamarind, Banyan or mango trees are present to furnish harbourage. In some localities, as at Manānūr, almost every large tamarind or Banyan tree holds a pair or two, and one has but to tap on the trunk to bring forth an inquiring little face to the entrance of a hollow or to dislodge a pair sitting huddled together on some secluded branch. Though largely crepuscular in its habits it seems little inconvenienced by sunlight and when disturbed flies from one tree to another without any apparent discomfort. I once even observed an individual chasing a Striped Squirrel in bright sunlight. They sally forth from their retreats at dusk and may then be commonly seen perched about on stakes or clods—even on the bare ground—or sailing close to the surface in search of grasshoppers, earthworms, mice, lizards, etc. The flexibility of their necks as with most owls is remarkable. The face can be screwed right round without altering the stanch of the body in the least, so

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that in fading light it is often difficult to tell if the bird is looking at or away from one!

Breeding: The organs of the specimens were in non-breeding condition. On 12 April a nest was found in the crevice of a ruined fort wall at Nirmal (at about 4 feet) containing one nearly full-fledged young with pirmaries sprouting and as yet unable to fly properly. The nest was a pad of coir fibres, quite clean and without any bones or excreta. On 15 April (Aurangābād) another nest was noted in a hole in an ancient wall at about 15 feet with three chicks in the same stage of growth.

Col. Sparrow has taken eggs in all stages of incubation and chicks (2 to 4 as a rule) at Trimulgherry, Nekonda and Rampoor between 11 March and 10 April.

Glaucidum radiatum radiatum (Tickell.). The Jungle Owlet.

Strix radiata Tickell, J.A.S.B., vol. ii (Nov. 1833), p. 572—Borabhum and Dholbhum.

Specimens collected: 181 ♂ 20-10-31 Farāhābād 2,800 ft.; 635 ? 3-4-32 Utnoor 1,250 ft.

Elsewhere noted at: Pāloncha.

Iris bright lemon-yellow; bill plumbeous- to greenish-yellow; feet dirty lemon-yellow; claws same, blackish at tips.

Only met with in forest, either singly or in pairs.

Gonads of the specimens in an undeveloped condition.

(To be continued).

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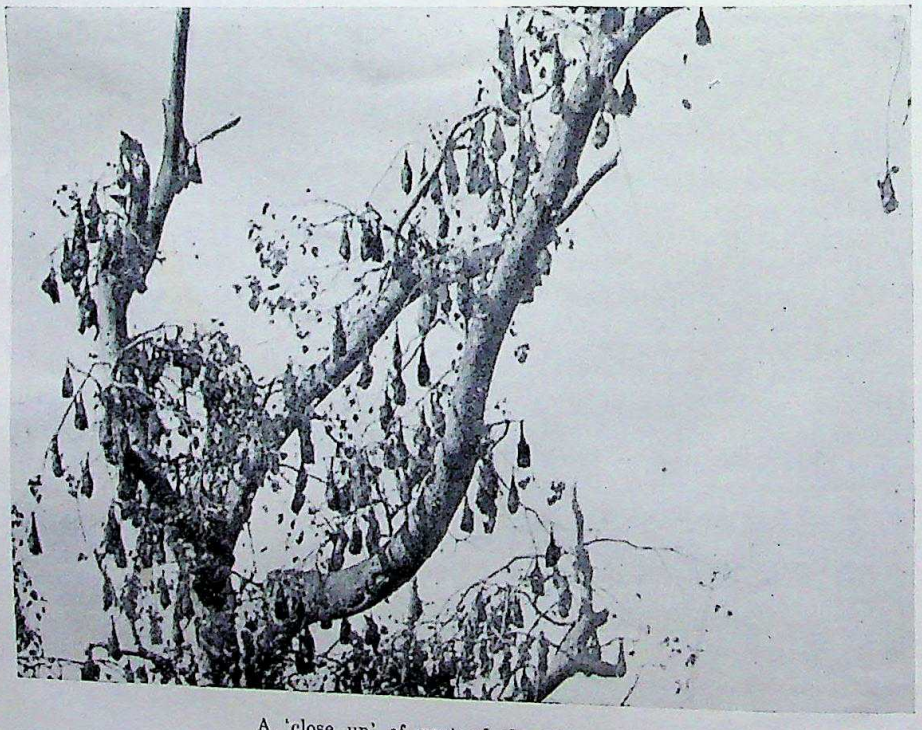
Colony of Flying-Foxes (*Pteropus giganteus* Brünn) at Malad, Salsette Island.



A 'close up' of part of the above colony.

Photos by Author.

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NOTES ON THE FLYING-FOX (*PTEROPUS GIGANTEUS*, BRÜNN.).

BY

CHARLES MCCANN, F.L.S.

(*With one plate*)

The Flying-Fox needs no introduction. It is the largest of the bats. Its weird shape, half rat and half 'bird' or Pterodactyle, finds its place in folklore and legend. The Evil Spirit is generally represented as one of these creatures. In a recent film Dracula was represented as a large bat, undoubtedly, a Flying-Fox, which was considered a vampire, sucking the life blood of its victims. However, this is slur on the true character of this nocturnal animal —it is a pure 'vegetarian'. We must leave the fantastic to the screen and legend and come down to hard facts. Nevertheless, it is noteworthy to observe that legend is frequently based on a natural history point which through ages has been distorted beyond recognition, as we shall presently see.

It is difficult to write anything without reviving and analysing the facts or fallacies recorded by previous writers. Some observation, no doubt, will stand their ground while others must be relegated to the shelves of fiction. Animals and plants are plastic living organisms which cannot be made to conform with man-made rules and regulations—there is as much 'individualism' among them as is to be found in Man. This, is what makes it extremely difficult to observe them and attribute definite reasons for their behaviour. Then again, this is made doubly difficult by the attitude adopted by the observer and his 'individualism' in explaining their actions.

The Flying-Fox, like most other bats is undoubtedly gregarious, at least, this is very much so at the time of roosting. Blanford states, 'Pteropi fly singly, never in flocks'. There is no doubt that they fly singly and not in close formation as do many gregarious birds, but I am of the opinion that certain parties meet and have particular beats when feeding. Flying-Foxes, as is well known, will always return to the same roost for years, and it takes much to drive them away once they have established themselves in a particular locality. EHA (E. A. Aitkin) (*J.B.N.H.S.*, vol. i, p. 144, 1886) observed several trees at Belapur, near Panvel, covered with Pteropi as far back as 1886 and I have no doubt that these colonies still persist in the same neighbourhood, and perhaps on the same trees, if the trees have not died or been removed.

Bombay city is regularly invaded every evening at dusk by large numbers of these animals. Most of them appear to come in from the north. Others come over the harbour from the mainland to the east. To the best of my knowledge, there are two roosts in

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the island of Bombay, one in the Victoria Gardens at Byculla and another in the grounds of the School of Art. Further north, on the island of Salsette, there are two large colonies, one at Malad[1] and the other at Thanna. At the above mentioned places they are to be found the whole year round, there is no tendency to migrate. These colonies I have known to exist in the same locality for well over 20 years. I have already mentioned the colony at Belapur, near Panvel. Mr. Salim A. Ali tells me that there is one at Kihim. To go further afield, I know of two other colonies, one at Kalyan and the other at Karli, near Lonavala. Mr. Humayun Ali informs me that there is one at Belapur, in the Ahmednagar district. It would be interesting to have a record of all the known colonies. This information would possibly help in studying the distribution and movements of these animals.

It is rather curious that these bats establish their colonies in the vicinity of villages, if not in their very midst. In all my experience, I do not ever remember coming across colonies in the jungles. They appear to be animals truly commensal with man. Generally, the tree which forms the roost is very thinly clothed with or devoid of leaves. This may possibly be due to one of two reasons, or both, the young shoots are broken off by the bats in their movements, or to the effect of the urine falling on the tender tissues of the plant.

To follow the activities of a colony would perhaps be the best way of describing their habits. Towards evening the whole colony is astir, much screeching and cantankerousness is evinced by every member as it gives itself a general 'clean up' before setting out. By nature, Flying-Foxes appear to be quarrelsome, and there is generally much ado about nothing. As the light begins to fade these nocturnal spirits move off by ones and two and in small parties till finally there is not a bat left at the roost. They do not all go in the same direction, but a few follow in the 'wake' of each other. Their first objective is the feeding grounds, these will depend on the fruit or flowers available at the time. *En route* they will have a drink at any tank or stream they may happen to fly over. I shall refer to this habit in more detail later on.

Once at its destination, the Flying Fox concentrates on feeding —now and again quarrelling with neighbours or intruders. It alights in a most clumsy manner on or near its objective. Once there, it moves about by means of its 'hooks' and feet. After feeding for a couple of hours or more, the bats hang about on the tree as they do at the roost. This appears to be an interval of rest. During the mating season this interval is occupied by sexual overtures. As they hang about there is frequently heard a 'clapping' noise, which is made by beating their semi-closed wings together. This clapping appears to me as though it were an invitation to

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[1] Since writing these notes, I visited this colony and found that the original roost, a *peepal* tree, has suffered much and in consequence died down considerably. The bats have now taken to the neighbouring trees rather than leave the locality.

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the opposite sex, but I could not definitely establish whether it was made by the female or the male, or by both, though I am inclined to believe the female is responsible for it. I have frequently observed an individual alight near a 'clapping' companion when copulation took place in the 'upside down' posture in which flying foxes hang. I have noticed copulation from October to December. About the middle of January I secured a fairly well advanced embryo. Judging from this, the period of gestation would be a short one. Tickell gives the time of birth as end of March to April, but I am inclined to give it a month earlier, for this part of the country (Bombay). However, this may vary with the locality and needs further investigation. To return to the activities of the flock. After a period of rest the animals feed again for a brief while and before dawn move off in the direction of their roost in the same manner as they left it.

The scene at the roost is one of confusion and commotion, and continuous fighting for position. Probably these bats return to the identical spot each morning. With the arrival of each new-comer, which circles round the roost a couple of times or more before coming to rest, the colony is thrown into confusion. This pandemonium does not cease till about 10 a.m., but at no time of the day is a colony really quiet. Too close approach to a neighbour is sufficient for a new quarrel. At the roost they hang upside down in true 'bat fashion' with the snout turned skywards and the whole snout enveloped in the wings. During the hottest part of the day several, if not the whole colony, will be found fanning themselves with one wing or the other. Much time is also spent in scratching, as the animals are usually infested with crab-like ticks, which seem to cause the bats much annoyance. In this way the hours of daylight are past. Looking at the confusion that exists among the members of such a colony one really wonders how much rest these animals get.

Let me now refer to some of the debated points in the life of these interesting creatures. It is hard enough for the naturalist to wrest a few points from the life of diurnal animals, but when it comes to the nocturnal! Well! with unaided diurnal eyes, I must say, I am blind.

Drinking.—Jerdon remarks, 'If water is at hand—a tank, a river, or the sea—they fly cautiously down and touch the water, but I could not ascertain if they took a sip or merely dipped part of their bodies in.' Many have no doubt observed this habit of Flying-Foxes as they pass over sheets of water. I have frequently observed these bats skimming over water, pause in their flight to sip the water in the same way as swallows. I have noticed that the head is lowered and the mouth is dipped into the water—I have no doubt that they *do* drink water—in fact, most bats do, if not all. I have frequently watched the Fruit Bat (*Cynopterus sphinx*) go down a well and do exactly the same thing. Dr. J. Shortt [*P.Z.S.* (1863), p. 438] in a letter to the Zoological Society of London attributed this habit of the Flying-Fox to catching fish. This is not likely, as I shall have occasion to show presently. The letter is of interest and as it is in an old number of that

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Journal, I take the liberty of reproducing it in full. It is as follows:—

"Sir,—

At about 6 p.m. on the 30th of April last, when at Conjeeveram, my attention was attracted to a tank next the Dispensary, which, owing to a light shower of rain that had just fallen, literally seemed alive with small fish gambolling and jumping about in the water. There was nothing new in this; but my attention was drawn to a number of large birds with a somewhat heavy flight, hovering over the water and seizing with their feet the fish, with which they then made off to some tamarind-trees on the bund of the tank, to devour them at their leisure, I suppose.

On a close examination, I discovered that what I had imagined mere birds were none other than flying-foxes, the *Pteropus edulis*. After watching them fishing for some time, I had to leave, owing to the darkness of the evening. I returned to the tank the next evening half an hour earlier, and again witnessed the same occurrence.

I then got my assistant, Mr. Watson, to bring his gun and shoot some, so that I might satisfy myself as to the identity of these animals. Mr. Watson shot some two or three whilst in the act of seizing their fishy prey, and on examination I found them to be actually Flying-Foxes. During a second visit, on the 5th and 6th of June, I observe the same thing occur again.

I am not aware of the fishing-propensities of this animal ever having been noticed, for I find no account of them in any work on natural history that I have had opportunities of consulting on the subject. This habit of the Flying-Fox appearing new to me, I send you this communication, as there may be others who have witnessed the same thing; and if made known, this would, I am sure, prove of interest to the naturalist.

Chingleput, June 12th, 1863."

It is rather a pity that Dr. Shortt after taking the trouble to secure the Flying-Foxes did not take the trouble to examine the stomach contents of the specimens. If he had, he would have soon been convinced that these animals do not catch fish at all, nor eat them. Blanford doubted Shortt's statement and quite rightly. However, with regard to these bats drinking salt water, I have very grave doubts. I have seen them taking a sip in the sea, but this I think is done in error.

Food.—Reverting to Shortt's letter, we find the statement that the bats were seizing fish 'with their feet'. Firstly, as I have said, Flying-Foxes do not eat fish; secondly, the feet are so constructed that they are only used as 'hangers' and not for conveying anything. Food, when conveyed, is carried in the mouth. I have frequently watched Flying-Foxes feeding on the fruit of *Bassia latifolia*, and when disturbed, they carried away the fruit in the mouth. Blanford (*F.B.I.* Mammalia, p. 258) quoting from Tickell writes, 'The bats hang, head downwards as usual, by one foot and hold the fruit with the other, not by grasping, but by sticking the claws in like a fork.' I have not observed this behaviour. My observations on these bats eating fruit are somewhat different. They hang in the usual manner by the legs. When chewing a large fruit, they either chew it without detaching it from its stalk, or hold it in the folded extremities ('wrists') of both the wings, or in the folds of one wing, where it is probably held in place by the phalanges. Be this as it may, I have not seen these bats use the feet as described by Tickell. I have seen insectivorous bats with large tail membranes use this interfemoral membrane

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as a sac and move the prey about with the feet while they suspended themselves with the 'hooks' on the wings.

No doubt many people have noticed the state of the ground below a tree where a party of Flying-Foxes has fed the night previous. The ground is littered with wholly or partially chewn remains of fruit—presumably the excreta of the bats—perhaps few people have ever seen the latter. From the looks of things, the bats must have gorged themselves. Legend has it that the flying-fox has no anus and that it must consequently pass the excreta from the mouth. The following extract from a note in the *Journal* by Fitzpatrick entitled *Folklore of Birds and Beasts in India* (*J.B.N.H.S.*, xxviii, 562) will not be out of place. It is told that the Almighty permitted Moses to try his hand at Creation.

"The second effort was not so successful, he still kept the ground plan of the rat and now put wings on the beast thus making the bat. As the Almighty imbued it with life, Moses in great excitement, called out 'My Lord and God, don't let it fly yet for I have forgotten the anus.' 'Too late,' said God, thus the bat flies without an anus." After repeated observations I am convinced that the Flying-Fox lives on juices and on fruit which liquefy easily, the harder parts being ejected. The ejection of the chewn residue of fruit was undoubtedly one of the points which gave rise to the popular belief quoted above, plus the fact that the bat hangs head downwards—perhaps a natural conclusion to the ignorant mind. Here we have a legend based on a crude observation which needs explanation.

Blanford (*loc.cit.*, p. 258) in a footnote writes, 'They are also fond of the fruit of *Terminalia catappa*, and are said by Day to extract the kernels, often utilizing the verandahs of houses as a resort while thus engaged, and alarming the inhabitants by sounds suggestive of house-breaking.' W. F. Sinclair in the *Journal* (vol. vii, p. 544) writes, 'Dr. Day's observation has been verified by two seasons' experience of burglarious bats at Tanna. When the tree is out of fruit the bats are "not-a-burgling".' That these bats do eat the fruit of *Terminalia catappa* I have had ample proof, that is, they suck out the juice and discard the hard portions. Often in their attempts to extract the juice they bite through the stones but they do not eat the kernels. Both the kernels and the seed coats will be found on the ground. In the morning Palm Squirrels feed on the kernels. With regard to these bats entering houses I have no evidence—I am doubtful whether they ever do. However, this point needs further confirmation.

In my note on the fertilization of *Grevillea robusta* A. Cunn. in this *Journal* (xxxvi, p. 763) I remarked 'It seems extraordinary that so large an animal could survive for several weeks on nectar alone . . .' This observation led me to investigate the food of these bats and examine the stomach contents of several specimens. A doubt arose in my mind as to whether these bats really ate the whole fruit or only extracted the juice and discarded the remains. It is common knowledge that the Flying-Fox and other fruit bats cause tremendous damage in orchards and perhaps rightly deserve to be relegated to the list of animals and birds harm-

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ful to crops. However, at the same time I do not for a moment suggest that they should be exterminated. We have yet to learn whether these 'destroyers' are not also beneficial.

My first subjects for dissection were naturally the specimens mentioned in my note quoted above. I expressed my doubts and views to Mr. Humayun Ali and asked him to keep a lookout for specimens, to dissect them and report the results to me. On the 31st August (1933) he wrote to me as follows:—'Yes, eventually I did manage to get down to Belapur (Ahmednagar District) and to the "battery". I shot five of them one morning and was glad to find that you were right. The stomach held no solid stuff whatever, not even seeds. The intestines were full of white, milky slime and one of the bats had a lot of dark viscous liquid in the stomach.' His statement supports my view.

Some time later, Dr. Laud, Superintendent of the Victoria Gardens, kindly sent me five specimens from the Byculla colony for dissection. These examples were shot early in the morning when to all reasonable expectation the stomachs should have been loaded. On dissection these animals were found to be extremely fat and well conditioned. Examination of the stomachs revealed nothing beyond a small quantity of viscous fluid. The intestines contained a similar liquid, but in the lower end of the intestines this fluid was yellowish brown, turning brown towards the extremity. In a single instance did I find five minute seeds of a fig in the stomach but none in the intestines. Surely, if these animals had eaten any solid food during the night, it would have betrayed itself in the lower end of the alimentary canal? However, this was not the case. Another point of interest is that none of the specimens dissected by me contained any large parasites either in the stomach or in the intestines.

Subsequent dissections of these animals have yielded the same results. Hence I think it is quite reasonable to conclude that Flying-Foxes subsist on liquid or semi-liquid foods, namely fruit juices and nectar and such fruit that are readily soluble. I have frequently observed these bats feeding on the nectar of the Silk Cotton Tree (*Bombax malabaricum*) besides the nectar from the flowers of the *Grevillea*. Beside the cultivated fruit trees I have observed them feeding on the following plants:—

Ficus bengalensis, L.
Ficus glomerata, Roxb.
Ficus infectoria, Roxb.
Ficus mysorensis, Heyne.
Ficus religiosa, L.
Ficus retusa, L.
} (Ripe fruit).

The Flying-Fox probably attacks the fruit of all the members of this genus.

Polyalthia longifolia, Bth. & Hk. f. (Ripe fruit).
Bombax malabaricum, DC. (Nectar from the flowers).
Calophyllum inophyllum, L. (Ripe fruit).
Bassia latifolia, Roxb. (Ripe fruit).

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Grevillea robusta, A. Cunn. (Nectar from the flowers).
Terminalia catappa, L. (Ripe fruit).

I have never known Flying-Foxes to feed on the fruit of the genus *Zyziphus*, this is probably due to the strongly armed nature of these trees. The menu of this bat is undoubtedly by far larger than what I have given.

Knud Anderson, in his *Catalogue of the Chiroptera in the Collection of the British Museum* (2nd. ed.) vol. i, p. 328 describing the feeding habits of the Flying-Fox writes, 'On captive specimens it has been observed that they chew the figs, until they have extracted the juice, when the remaining pulp is ejected out of the mouth; glutinous and farinaceous food, such as plantains, they do not serve in this manner.' In these few lines we observe what I have stated above. If this is true of specimens in captivity why should it not also apply to the animals in the natural state? The habit of the Flying-Fox of ejecting the solid portions of the fruit it eats accounts for the large amount of litter found under the trees where they have been feeding.

Miscellaneous.—Indians consider the fat of these animals very efficacious in cases of rheumatism (like tiger and other fats) and for baldness. It is also said that the bone from the wing of a flying-fox tied to the ankle with hair from the tail of a black cow will ensure painless childbirth. I am not in a position to vouch for the truth of this statement!

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THE FLORA OF WAZIRISTAN.

BY

E. BLATTER, S.J., PH.D., F.L.S., and J. FERNANDEZ.

PART III.

(*Continued from page 977 of vol.* XXXVI).

(*With two plates*).

CAESALPINIACEAE.

CASSIA Tourn. ex L.

400 species.—Tropics and warm temperate regions.

Cassia sophera L. Sp. Pl. (1753) 379.
Locality: Waziristan (Duthie's Collect. 15734).
Distribution: In most tropical countries, probably of American origin.

CERATONIA L.

1 species.—Mediterranean.

***Ceratonia siliqua** L. Sp. Pl. 1026.
Vernacular name: Carob Tree.
Locality: *N.W.*: Miram Shah (B. & F. 46 !).
Distribution: E. Mediterranean region.

MIMOSACEAE.

PROSOPIS L.

30 species.—Tropics and subtropics.

Prosopis Stephaniana Spreng. Syst. ii, 726.
Locality: *Tank* (Stewart).
Flowers: April 1860 (Tank).
Distribution: Peshawar, Afghanistan, Orient, Mediterranean.

ACACIA (Tourn.) L.

550 species.—Tropics and subtropics.

Acacia arabica Willd. Sp. Pl. iv (1805) 1085.
Locality: *Tank*: City of Tank, abundant (Stewart).
Distribution: India, Ceylon, Arabia, Egypt, tropical Africa, Natal.

Acacia Farnesiana Willd. Sp. Pl. iv (1805) 1083.
Vernacular name: Walayti kikar (Hind).
Locality: *N.W.*: Miram Shah, cultivated (B. & F. 27 !).
Tank (Stewart).
Flowers & Fruit: 19-3-30 (Miram Shah).
Flowers: April 1860 (Tank).
Distribution: Indigenous in America, naturalized throughout India and Burma.

Acacia Jacquemontii Benth. in Hook. Journ. Bot. i, 409.
Locality: *S.W.*: Above Palosina (Stewart).
Distribution: Punjab plains and Outer Himalaya up to 3,000 ft., Gujarat, Rajputana, Sind, Baluchistan, Trans-Indus.

Acacia modesta Wall. Pl. As. Rar. ii (1831) 27, t. 130.
Vernacular name: Palessa, Palosa (Waziri), Pulosa.
Locality: *N.W.*: Miram Shah, 3,000 ft. (F. 947 ! 1397 ! 1398 !, B. & F. 3 !).—Boya, 4,000 ft. (F. 1515 !), open stony plain (F. 4350 !).—Razani,

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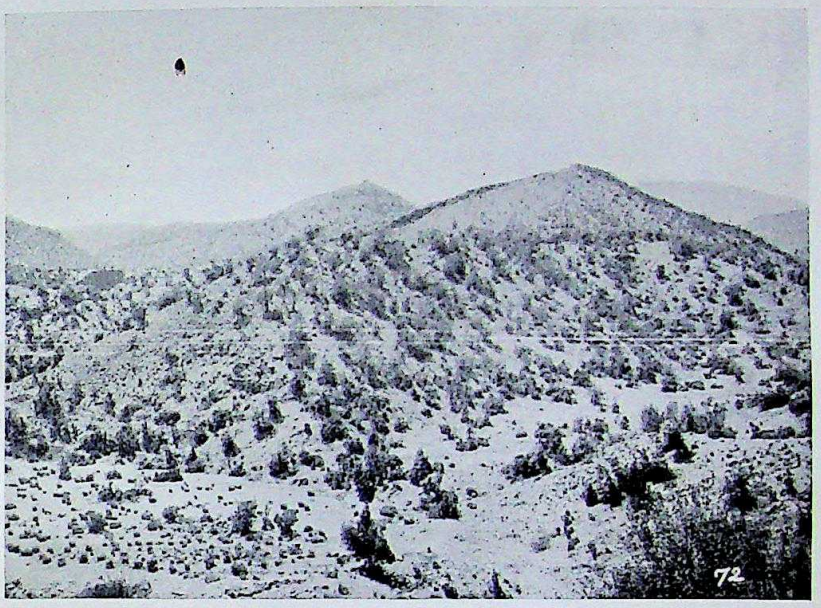
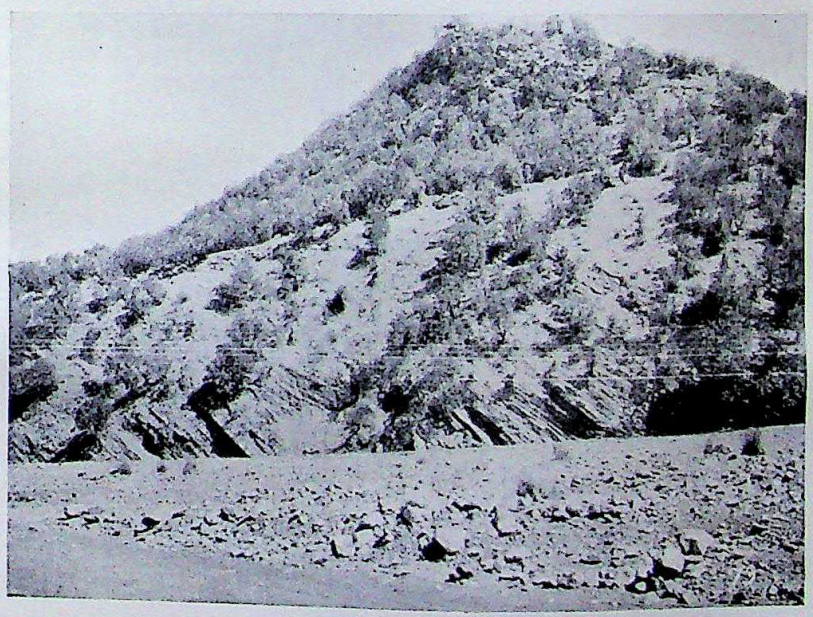


8. Near Razani due West. Mostly *Quercus ilex* L. *Olea cuspidata* Wall. and *Sophora mollis* Grah.



9. Right bank of Khunai River above Dossali Fort with *Olea cuspidata* Wall., *Monotheca buxifolia* Dene.; *Sophora mollis* Grah. and grass.

Photos by J. Fernandez.

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5,000 ft. (Stewart).—Siroba (Stewart).—Above Khirgi (Stewart).—Spinwam, 2,650 ft. (B. & F. 959 !).—Shewa Post, bank of Volam River (B. & F. 886 !).

S.W.: Palosina (Stewart).—Sarwekai, common on hills and here and there in stony plain, 3,200 ft. and higher (F. 3954 !).—Jandola, open stony ground and nalas, 2,200 ft. (F. 668 ! 676 ! 696 ! 4206 !).—Dargai Post, on hillsides (F. 3721 ! 3722 ! 3723 !).—Sararogha, 4,000 ft. (F. 179 ! 180 ! 594 ! 598 ! 614 !), in dry nala W. of Camp and along dry stony slopes in the nala area (F. 597 !).

Tank: Near Tank (J. Williams !).—Zam Valley, N.-W. of Tank (Stewart !).

Flowers: April, May.

Fruit of previous year still on tree in March.

Distribution: Baluchistan, Salt Range, Sind Sagar Doab, Sub-Himalayan tract and Outer Himalaya from the Jumna westwards to 4,000 ft.

Acacia eburnea Willd. Sp. Pl. iv (1805) 1081.—*Mimosa eburnea* Roxb. Corom. Pl. t. 199.

Locality: *S.W.*: Sararogha, dry nalas W. of Camp, along dry stony slopes in nala area, 4,000 ft. (F. 147 ! 150 ! 581 ! 595 !).—Jandola, open stony ground and nalas, 2,270 ft. (F. 674 ! 677 !).

Fruit: May.

Distribution: Arabia, Afghanistan, Baluchistan, Salt Range, Sub-Himalayan tract and outer valleys, up to 3,000 ft., east as far as Oudh, Sind, Deccan, Ceylon. (Parker says that it does not occur in the Punjab).

SAXIFRAGACEAE.

750 species.—Cosmopolitan, chiefly temperate.

*Saxifraga (Tourn.) ex L.

325 species.—N. temperate, Arctic, Andes, chiefly alpine.

***Saxifraga Petraschii** Sünderm. = *S. tombeanensis* Boiss. × *S. Rocheliana* Sternb.

Locality: *S.W.*: Razmak, in garden (B. & F. !).

Flowers: April.

Distribution: Parents from S. Tyrol, N. Italy and Bosnia, N. Albania respectively.

Bergenia Moench.

10 species.—E. Asia.

Bergenia ligulata Engl. in Bot. Zeitg. xxvi (1868) 840.—*Saxifraga ligulata* Wall. in As. Res. xiii, 398.

Vernacular name: Kamargul (Waziri).

Locality: *S.W.*: Near Kaniguram, about 6,500 ft. (Stewart).—Pre Ghal (J. Williams 7816 !).—Shuidar, 9,000-11,000 ft. (F. 2541 !); 7,000-8,000 ft., between rocks together with *Selaginella* and ferns (F. 1557 !).—Razmak (F. 1798 !).

Flowers: 18-4-30, 8-5-27 (Shuidar); 8-8-1888 (Pre Ghal); September 1860 (Kaniguram).

Distribution: Temperate Himalaya, from Kashmir to Bhutan, 7,000-10,000 ft., Khasia Hills, Kuram Valley.

Bergenia Stracheyi (Hook. f. & Th.) Engl. in Bot. Zeitg. (1868) 842.—*Saxifraga Stracheyi* Hook. f. & Th. in Journ. Linn. Soc. ii (1858) 61.

Locality: *S.W.*: Pre Ghal (Duthie's Collect. 15608 !).

Flowers: 17-5-1895 (Pre Ghal).

Distribution: W. Himalaya, from Kashmir to Kumaon, 8,000-14,000 ft. Afghanistan.

Parnassia (Tourn.) L.

25 species.—N. temperate region, chiefly in mountain bogs.

Parnassia nubicola Wall in Wight Ill. t. 21.

Locality: *S.W.*: Pre Ghal (Hay).

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Ribes L.

60 species.—N. temperate and Andes.

Ribes orientale Desf. Hist. Arb. ii (1809) 88; Boiss. Fl. Or. ii (1872) 817.
Locality: *S.W.*: Razmak, 6,500 ft. (F. 1606 ! 1608 ! 1646 !).—Shuidar 11,000 ft. (F. 2474 !).
Young leaves: 8-5-27 (Razmak).
Distribution: Afghanistan, Kuram Valley, Baluchistan, Kashmir, inner arid Himalaya, 8,000-12,000 ft., Lahul, Kunawar, Kumaon, West Tibet, mountains of Greece and W. Asia.

CRASSULACEAE.

450 species.—Cosmopolitan, chiefly S. Africa.

Sedum Tourn. ex L.

150 species.—N. temperate.

Sedum adenotrichum Wall. Cat. 7231.
Locality: *S.W.*: In the upper regions (Stewart).—N. of Razmak, below Springs, 7,700 ft. (B. & F. 1801 ! 1870 !).—Slopes of Shuidar, 9,000-11,000 ft. (F. 1546 !).
Flowers & Fruit: 18-4-30 (Shuidar); 25-4-30 (Razmak); 8-5-27 (N. of Razmak).
Distribution: W. Himalaya, Kashmir to Kumaon, 3,000-8,000 ft., Afghanistan 11,000 ft.

Sedum Ewersii Ledeb. Fl. Alt. ii, 191.
Locality: *S.W.*: Pre Ghal (Hay).
Distribution: Temperate and alpine Himalaya, 9,000-17,000 ft., alpine Siberia, Soongaria.

Sedum adenocalyx Blatter *sp. nov.* [*Crassulacea. Refert S. adenotrichum* Wall. *sed facile distinguitur pedicellis brevissimis* (1-1.5 *mm.*), *sepalis oblongo-linearibus obtusis, extus dense glanduloso-pubescentibus, petalis ovato-acuminatis vel cuspidatis sepala paullum tantum superantibus, seminibus linearioblongis, laevibus.*]

Perennis (?), *pluricaulis, caules steriles abbreviatos emittens. Caules crassi, carnosi, ascendentes usque ad* 8 *cm. alti, dimidia parte superiore dense glanduloso-pubescentes. Folia crassa, complanata, glabra, radicalia laxe rosulata spathulata, apice obtusa vel subacuta, ad* 16 *mm. longa et* 4 *mm. lata, caulium sparsa, forma radicalium, ad* 10 *mm. longa et* 3 *mm. lata, sensim breviora et angustiora, caulium sterilium abbreviata. Panicula brevis, tota dense glandulosa-pubescens, cymis* 2-3*-floris bracteatis constans; pedicelli brevissimi,* 1-1.5 *mm. longi. Flores* 3 *mm. longi. Sepala libera fere ad basin, oblongo-linearia, attenuata versus apicem, obtusa, extus dense glanduloso-pubescentia,* 2.5 *mm. longa, ca.* 1 *mm. lata. Petala albida, libera fere ad basin, ovato-acuminata vel cuspidata, sepala paullum superantia, intus glabra, extus nervo medio parce glanduloso-pubescentia. Stamina* 10, 5 *breviora. Carpella* 5, *erecta, pallide brunnea, ovato-acuminata, apice capitatula. Semina multa minima, pallide brunnea, lineari-oblongo, ad basin et apicem rotunda, laevia, glabra.*

Perennial (?), several-stemmed, giving off abbreviated sterile stems. Stems stout, fleshy, ascending, up to 8 cm. high, upper half densely glandular-pubescent. Leaves fleshy, flat, glabrous, radical ones rosulate, spathulate, obtuse or subacute at the apex, up to 16 mm. long and 4 mm. broad, stem-leaves not very dense, resembling the radical leaves in shape, up to 10 mm. long and 3 mm. broad, getting slowly narrower and shorter, leaves of sterile stems abbreviated. Panicle short, the whole glandular-pubescent, consisting of 2-3-flowered bracteate cymes; pedicels very short, 1-1.5 mm. long. Flowers 3 mm. long. Sepals free almost to the base, oblong-linear, attenuate towards the apex, obtuse, outside densely glandular-pubescent, 2.5 mm. long, ca. 1 mm. broad. Petals whitish, free almost to the base, ovate-acuminate or cuspidate, slightly longer than the sepals, inside glabrous, outside along the midvein sparingly glandular-pubescent. Stamens 10, 5 shorter. Carpels 5, erect, pale brown, ovate-acuminate, at the apex a small head. Seeds small, many, pale brown, linear-oblong, rounded at the base and apex, smooth, glabrous.

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Locality: *N.W.*: Loargai Narai, in wooded ravine, together with mosses and lichens, 6,600 ft. (B. & F. 1307 ! type, 1307a ! cotype).
Flowers & Fruit: 16-4-30.

MYRTACEAE.

2,800 species.—Warm regions, chief centres Australia and tropical America.

*Psidium L.

110 species.—Tropical America, W. Indies.

***Psidium Guyava** L.
Vernacular name: Guava.
Locality: *S.W.*: Razmak, in garden (B. & F. !).
Distribution: Indigenous in Mexico.

*Myrtus (Tourn.) L.

70 species.—Tropics and subtropics.

***Myrtus communis** L.
Vernacular name: The Myrtle.
Locality: *N.W.*: Miram Shah (B. & F. !).
Distribution: S. Europe, extending to Afghanistan.

*Callistemon R. Br.

12 species.—Australia.

* **Callistemon lanceolatus** DC. Prodr. iii, 223.
Vernacular name: Bottle Brush Tree.
Locality: *N.W.*: Miram Shah (B. & F. 32 !).
Flowers: 19-3-30 (Miram Shah).
Distribution: Indigenous to Queensland and New South Wales.

*Eucalyptus L'Herit.

230 species.—Australia, 2 or 3 Indo-Malaya.

***Eucalyptus rostrata** Schl. in Linnaea xx (1847) 655.
Locality: *N.W.*: Miram Shah, garden (F. 2367 !).
Flowers: 12-4-27.
Distribution: Indigenous to all the states of Australia, mainly inland.

***Eucalyptus sp.**
Locality: *N.W.*: Miram Shah Fort, garden, 3,150 ft. (B. & F. 40A !).
Flowers: 19-3-30 (Miram Shah).

PUNICACEAE.

2 species.—Socotra, from the Balkans to the Himalayas, and cultivated.

Punica (Tourn.) L.

Punica granatum L. Sp. Pl. (1753) 472.
Vernacular name: Narghesa (Waziri).
Locality: *N.W.*: Razani, in jungle amongst rocks, 5,000 ft. (F. 2072 ! 2087 ! 2088 !).—Miram Shah (F. 346 !).—Dwa Warkha, abundant (Stewart).—Spinwam (B. & F. 798 !).—Boya, 4,000 ft., cultivated (F. 1348 ! 1352 !).—Shewa Post (B. & F. 909 !).
S.W.: Sararogha, stony hillside, 4,000 ft. (F. 166 !).—Wana, 4,500 ft., cultivated (F. 3552 ! 3553 !).—Barrarra Pass, growing wild (Stewart).
Flowers: May.
Distribution: Indigenous in Persia, Afghanistan, Baluchistan, Hazara and Himalaya, 3,000-6,000 ft. Elsewhere cultivated.

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LYTHRACEAE.

500 species.—All zones but frigid.

Ammannia (Houst.) L.

20 species.—Cosmopolitan.

Ammannia verticillata Lam. Encycl. i (1783) 131 *et* Ill. i (1791) 312, t. 77, f. 3; Boiss. Fl. Or. ii (1872) 743; *excl. synon.—A. salicifolia* Monti Comm. Acad. Bonon. v, I Opusc. (1767) 112 *cum tab.*; Sabnis Fl. Sind (1923-24) 30.
Locality: *S.W.*: Dargai Post, along stream (F. 3742 !).
Flowers: June.
Distribution: Italy, Montenegro, Lycia, Syria, Kurdistan, Transcaucasus, Persia, Afghanistan, Sind.

Ammannia sp.
Locality: *N.W.*: Datta Khel, along canals, 4,500 ft. (F. 1222 !).

ONAGRACEAE.

500 species.—Temperate and tropical regions.

Epilobium Dill. ex L.

160 species.—Temperate and arctic regions.

Epilobium angustifolium L. Sp. Pl. 347.
Locality: *S.W.*: Pre Ghal (Hay !).—Razmak, planted (B. & F. !).
Distribution: Temperate W. Himalaya, 8,000-12,000 ft., Orient, Europe, N. America.

Epilobium minutiflorum Haussk. in Oest. Bot. Zeitschr. 29 (1879) 55.
Locality: *S.W.*: Pre Ghal (Hay).
Distribution: Syria.

CUCURBITACEAE.

750 species.—Chiefly tropics.

Cucumis (Tourn.) L.

25 species.—Tropics and subtropics.

Cucumis prophetarum L. Cent. Amoen. Academ. 4 (1759) 295; Boiss. Fl. Or. ii (1872) 758.
Vernacular name: Khatkai (Waziri).
Locality: *S.W.*: Wana, near stream, S.-E. of Camp, 4,500 ft. (F. 3593 !), stony plain (F. 3468 !).
Flowers: June.
Distribution: Egypt, Nubia, Abyssinia, Kordofan, Arabia, Socotra, Baluchistan, Sind, Rajputana Desert.

Cucumis melo L. Sp. Pl. 1011.
Popular name: Melon.
Locality: *S.W.* (J. Williams 7146 !).
Flowers: 4-5-1888.
Distribution: Origin uncertain. De Candolle considers it to be probably a native of N.-W. India, Baluchistan and perhaps tropical Africa.

Citrullus Forsk.

4 species.—Africa, Mediterranean, tropical Asia.

Citrullus colocynthis Schrad. in Linnaea xii (1838) 414; Boiss. Fl. Or. ii (1872) 759.—*Cucumis colocynthis* L. Sp. Pl. (1753) 1011.
Vernacular name: Colocynth gourd; Madagini (N. Waziristan), Madaigini (S. Waziristan).
Locality: *N.W.*: Miram Shah, open stony ground, 3,000 ft. (F. 318 ! 441 ! 442 ! 464 ! 672b !), sandy banks of Tochi (F. 369 !).—E. of Spinwam

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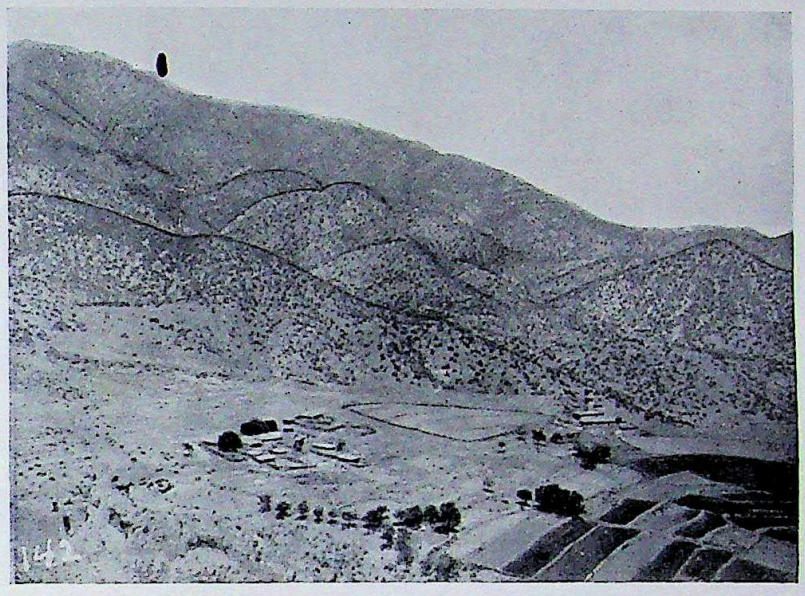

10. Looking across Dirdoni village from below Alexandra Picket. Note the dense growth of *Quercus ilex* L. on the ranges.

11. Almost pure formation of *Adhatoda vasica* Nees in a side nala of Kaitu River at Spinwam Fort.

Photos by J. Fernandez.

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Fort, sandstone nala (B. & F. 672 !).—Chasmai River, bed, 3,100 ft. (B. & F. 346 !).

S.W.: (Duthie's Collect. 15737 !).—Sararogha, stony plain, 4,000 ft. (F. 43 ! 195 ! 200 !).—Jandola, stony ground, 2,200 ft. (F. 660 !), dry slopes on Tank River (F. 770 !).—Sarwekai, stony plain, 3,200 ft. (F. 3928 !). —Pre Ghal (J. Williams 7820 !).

Distribution: Spain, Canaries, Cape Verde Islands, N. Africa, Arabia, Palestine, Mesopotamia, Persia, Afghanistan, Baluchistan, Punjab, Sind, Indian Desert, India, Ceylon.

FICOIDACEAE.

(*Aizoaceae.*)

650 species.—Chiefly S. Africa but also in California, S. America, tropical Africa and Asia, Australia.

Trianthema L.

13 species.—Tropics.

Trianthema pentandra L. Mant. (1767) 70.
Locality: *Tank*: At and near Tank (J. Williams 7823 ! 7964 !).
Flowers: 5-6-1888 (Tank).
Fruit: 4-5-1888 (Tank).
Distribution: Sind, Rajputana Desert, Punjab, Baluchistan, tropical Africa
Uses: Leaves used as poultice in guinea worm (Williams).

Orygia Forsk.

1 species.—Africa to India.

Orygia decumbens Forsk. Fl. Aeg.-Arab. (1775) 103.
Locality: *N.W.*: Dwa Warkha (Stewart).
Distribution: Sind, Baluchistan, Punjab, Rajputana, Mysore, Coimbatore, W. Asia, Africa.

Mollugo L.

15 species.—Tropics and N. America.

Mollugo pentaphylla L. Sp. Pl. (1753) 89.—*M. stricta* L. Sp. Pl. ed. ii (1762) 131.
Locality: *Tank* (J. Williams 7127 !).
Flowers: 9-5-1888 (Tank).
Distribution: Throughout India and Ceylon, eastwards to Malay Peninsula, China, Japan, Fiji.

ARALIACEAE.

700 species.—Chiefly tropical, especially Indo-Malayan, tropical America.

Hedera Tourn. ex L.

5 species.—Temperate regions.

Hedera Helix L. Sp. Pl. (1753) 202.—*H. himalaica* Tobler Die Gattung Hedera (1912) 67-79.
Vernacular name: Parvatiae (Waziri).
Locality: *N.W.*: Razmak Narai, on slope of ravine, 7,000 ft. (B. & F. 1227 !).

S.W.: N. of Razmak, below Springs, on rocks and trees, 7,700 ft. (B. & F. 1842 !, F. 1769 ! 1873 ! 2315 !).
Distribution: Throughout the Himalaya 6,000-10,000 ft., Khasia, from W. Europe to Japan.

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CAPRIFOLIACEAE.

275 species.—Temperate regions and tropical mountains.

Viburnum L.

110 species.—Temperate and subtropical regions, especially Asia, N. America.

Viburnum cotinifolium D. Don Prodr. Fl. Nep. (1825) 141.
Locality: *S.W.*: Kaniguram, about 8,200 ft. (Stewart).—Razmak (F. 1861 ! 1906 !).—N.-E. of Razmak (Stewart).
Flowers: May.
Distribution: Himalaya, 4,000-11,000 ft., Trans-Indus to Bhutan.

Abelia R. Br.

15 species.—Asia, Mexico.

Abelia triflora R. Br.: **var. parvifolia** C. B. Clarke in Hook. f. Fl. Brit. Ind. iii (1880) 9.
Locality: *S.W.*: Kaniguram, 8,500 ft. (Duthie's Collect. 15793 !, Stewart).
Flowers: 18-5-1895 (Kaniguram).
Distribution: Himalaya, 5,000-10,000 ft., from the Indus eastwards.

Lonicera L.

100 species.—N. hemisphere.

Lonicera obovata Hook. f. & Th. in Journ. Linn. Soc. ii, 169.
Locality: *S.W.* (Duthie's Collect. 15796 !).
Distribution: Temperate Himalaya, from Kashmir to Kumaon, 8,000-13,000 ft., Sikkim, 12,000-14,000 ft.

Lonicera quinquelocularis Hardw. in As. Res. Soc. Beng. vi (1799) 351.
Vernacular name: Pastavaniae, Galashanki (Waziri).
Locality: *S.W.*: Near Kaniguram, about 8,200 ft. (Stewart).—Razmak (F. 1864 ! 1915 ! 3104 ! 3341 !).
Distribution: N.-W. Himalaya, Baluchistan, Kuram Valley, Bhutan, China.

***Lonicera sp.**
Locality: *N.W.*: Miram Shah Fort, Officers' Garden (B. & F. 528 !).
Flowers: 28-3-30.

Lonicera sp.
Locality: *S.W.*: Kaniguram (Stewart).

RUBIACEAE.

5,500 species.—Mostly tropical, a number temperate.

Randia Houst. ex L.

125 species.—Tropics.

Randia tetrasperma Benth. & Hook. f. in Gen. Pl. ii (1873) 88.—*Gardenia tetrasperma* Roxb. Fl. Ind. i (1832) 709.
Locality: *S.W.*: Barrarra Pass, not uncommon (Stewart).
Distribution: Salt Range and subtropical Himalaya from Kashmir eastwards, ascending to 4,000-6,000 ft. in Kumaon and to 7,000 ft. in Sikkim and Bhutan, Assam, Sylhet.

Gaillonia A. Rich.

12 species.—Nubia to India.

Gaillonia hymenostephana Jaub. & Sp. Ill. Pl. Or. i (1842) 146, t. 79.
Locality: *S.W.*: Wana, 4,500 ft. (Duthie's Collect. 15786 !), 3,500 ft. (Stewart ex J. D. Hooker).—Barwand, 4,000 ft. (Duthie's Collect. 15779 !).
Flowers: 21-4-1895 (Barwand), 17-5-1895 (Wana).
Distribution: Punjab, Baluchistan, Afghanistan, Arabia.

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RUBIA (Tourn.) L.

15 species.—Europe, Asia, America.

Rubia cordifolia L. Syst. ed. xii, 229.
Vernacular name: Warwaga (Williams).
Locality: *S.W.*: 8 miles below Kaniguram village (Stewart).—Pre Ghai (J. Williams 7832 !).—Razmak, towards springs, 6,750-7,300 ft. (B. & F. 1767 !, F. 1882 !).
Fruit: 11-8-1888 (Pre Ghal).
Distribution: Throughout the hilly districts of India, from the N.-W. Himalaya to Ceylon and Malay Peninsula, Dahuria to Japan and Java, tropical Africa.

Rubia infundibularis Hemsl. & Lace in Journ. Linn. Soc. xxvii (1891) 324.
Locality: *S.W.*: Pre Ghal (J. Williams 7833 !).
Fruit: 1-8-1888 (Pre Ghal).
Distribution: Baluchistan, Afghanistan.

Rubia albicaulis Boiss. Diagn. ser. 1, iii, 53, **var. stenophylla** Boiss. Fl. Or. iii, 19.
Locality: *S.W.*: (J. Williams 9155 !).—Kaniguram, 6,500 ft. (Duthie's Collect. 15770 !).
Flowers: 14-5-1895 (Kaniguram).
Fruit: 6-7-1888 (S. Waz.).
Distribution: Persia, Afghanistan.

GALIUM L.

250 species.—Cosmopolitan.

Galium aparine L. Sp. Pl. 108; Boiss. Fl. Or. iii, 68.
Vernacular name: Babrezie (Waziri).
Locality: *N.W.*: Razani (Stewart).—Datta Khel Fort, stony plain 4,600 ft. (B. & F. 1331 !).—4 miles E. of Datta Khel, on gravel (B. & F. 601 ! 605 !).—Boya, 3,550 ft. (B. & F. 86 !).—Miram Shah (F. 507 !), hills E. of caves, 3,600 ft. (B & F. 533 !).—Dossali Fort, nala, among tufts of grass (B. & F. 1022 !), right bank of Khaisora River (B. & F. 1163 !).
S.W.: Near Kaniguram (Stewart).—Lower slopes of Shuidar, up to 5,700 ft. (B. & F. 1615 !).—Razmak, stony plain (F. 3187 !).
Flowers & Fruit: 21-3-30 (Boya); 30-3-30 (Datta Khel); 10-4-30 (Dossali); 13-4-27 (Miram Shah); 16-4-30 (Datta Khel); 18-4-30 (Shuidar); 5-5-27 (Razmak).
Distribution: Temperate Himalaya up to 12,000 ft., from Kashmir to Sikkim, N. and W. and Central Asia, N. Africa, Europe.

Galium tricorne Stokes in With. Bot. Arr. Brit. Pl. ed. II, i, 153.
Vernacular name: Chapreth (Waziri).
Locality: *N.W.*: Datta Khel (F. 1253 !), in garden, 4,600 ft. (B. & F. 1387 !).—Dossali, nala (B. & F. 1062 !).
S.W.: (Stewart).—Razmak, stony plain (F. 2683 !).
Flowers & Fruit: 25-3-27 (Datta Khel); 11-4-30 (Dossali); 17-4-30 (Datta Khel); 29-4-27 (Razmak).
Distribution: W. Himalaya, Orient, Europe, N. Africa.

Galium spurium L. Sp. Pl. (1753) 154.
Locality: *S.W.*: Razmak, stony plain, 6,800 ft. (B. & F. 1748a !).
Flowers & Fruit: 24-4-30 (Razmak).

Galium setaceum Lam. Encycl. ii, 584; Boiss. Fl. Or. iii, 77.—*G. capillare* Cav. Ic. t. 191, f. 1.
Locality: *S.W.*: Wana, 4,500 ft. (Duthie's Collect. 15784 !).
Flowers: 5-5-1895 (Wana).
Distribution: Temperate Asia, Punjab, Baluchistan, Afghanistan, Mediterranean.

Galium sp.
Locality: *S.W.*: (Duthie's Collect. 15615).

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CALLIPELTIS Stev.

3 species.—Egypt to Persia.

Callipeltis cucullaria DC. Prodr. iv, 613.
Vernacular name: Packikt boti (Williams).
Locality: *S.W.*: Shaur Hill (J. Williams 2591 !).—Wana (Duthie's Collect. 15629 !).
Flowers: 1-5-1895 (Wana).
Distribution: Baluchistan, Afghanistan, Persia, Orient, Asia Minor, Mediterranean, N. Africa.

VALERIANACEAE.

350 species.—Europe, Asia, Africa, America.

VALERIANA Tourn. ex L.

200 species.—Europe, Asia, Africa, America.

Valeriana Wallichii DC. Mem. Valer. 15, t, 4.
Vernacular name: Kamargul (Waziri).
Locality: *S.W.*: Razmak.—Pre Ghal (J. Williams 7834 ! 7835 !, Duthie's Collect. 15604 !).
Flowers: May, 16-5-1895 (Pre Ghal).
Fruit: 9-8-1888; 14-8-1888 (Pre Ghal).
Distribution: Afghanistan, Kuram Valley, temperate Himalaya from Kashmir to Bhutan, 10,000 ft., Khasia Hills, 4,000-6,000 ft.

Valeriana dioica L. Sp. Pl. 44.
Locality: *S.W.*: (Duthie's Collect. 15643 !).
Distribution: Europe, Central Russia, Asia Minor.

Valeriana sp.
Locality: *S.W.*: Upper regions (Stewart).

VALERIANELLA Tourn. ex Hall.

50 species.—N. temperate regions.

Velerianella Szovitziana Fisch. & Mey. Ind. Sem. iii, Petrop. 18.
Locality: *N.W.*: Left bank of Dariawasti Algad (B. & F. 1662 !).—N. of Boya Fort near Tochi River, 3,550 ft. (B. & F. 1693 !).—Near Miram Shah, bed of Chasmai River, 3,100 ft. (B. & F. 317 !).
S.W.: Slopes of Shuidar, 7,000-9,000 ft. (B. & F. 1593 !).—Barwand, 4,000 ft. (Duthie's Collect. 15775 !).—Near Kaniguram, about 6,500 ft. (Stewart).
Flowers & Fruit: 24-3-30 (Chasmai River); 18-4-30 (Shuidar); 19-4-30 (Dariawasti Algad); 21-4-30 (Boya).
Fruit: 26-4-1895 (Barwand).
Distribution: Kashmir, Afghanistan, Persia, Arabia, Syria, Asia Minor.

CAMPANULACEAE.

1,000 species.—Temperate and subtropical regions.

CAMPANULA (Tourn.) L.

300 species.—N. temperate regions and tropical mountains, especially Mediterranean.

***Campanula Medium** L. Sp. Pl. 167.
Vernacular name: Canterbury Bells.
Locality: *S.W.*: Razmak, in garden (B. & F. !).
Distribution: S. Europe.

Campanula leucoclada Boiss. Diagn. ser. 2, iii, 109.—*C. Griffithii* Hook. f. & Th. in Journ. Linn. Soc. ii (1858) 22.
Locality: *S.W.*: Wana, 4,500 ft. (Duthie's Collect. 15787 !).

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Flowers: 8-5-1895 (Wana).
Distribution: Afghanistan, Baluchistan, Kuram Valley.

Campanula sp. near *C. sylvatica* Wall.
Locality: *S.W.*: (Duthie's Collect. 15771 !).

Campanula sp.
Locality: *S.W.*: Kaniguram (Stewart).

PLUMBAGINACEAE.

280 species.—Cosmopolitan, especially on salt steppes and seacoast.

Acantholimon Boiss.

80 species.—E. Mediterranean (desert plants).

Acantholimon sp.
Vernacular name: Drab (Waziri).
Locality: *N.W.*: Near Datta Khel village, 4,600 ft., on gravel, forming a low mat several feet in diam. (B. & F. 1434 !).

Statice Tourn. ex L.

130 species.—Cosmopolitan, chiefly in steppes and salt marshes.

Statice axillaris Forsk. Fl. Aeg.-Arab. 58.
Locality: *S.W.*: Wana, in rock-crevices on hills (F. 3425 !).
Distribution: Baluchistan, Arabia, Egypt.

Statice cabulica Boiss. in DC. Prodr. xii, 666; Fl. Or. v, 871.
Locality: *N.W.*: Boya (F. 4258 !).
Distribution: Punjab, 2,000-4,000 ft., Afghanistan.

Statice macrorrhabdos Boiss. Diagn. ser. 2, iv, 67.
Vernacular name: Garbeta (Waziri).
Locality: *N.W.*: 2 miles above Dossali Fort, hills on right bank of Khunai River, 5,150 ft. (B. & F. 1142 !).—Boya, stony plain (F. 422 ! 928 !).
S.W.: Barwand, 4,000 ft. (Duthie's Collect. 15635 !).
Flowers: 27-3-27 (Boya); 12-4-30 (Dossali); 29-4-1895 (Barwand).
Distribution: Baluchistan, Afghanistan.

Statice Griffithii Aitch. & Hemsley in Journ. Linn. Soc. xviii, 175, pl. xxiii, f. 1-4.
Locality: *N.W.*: E. of Spinwam Fort, stony nala, 2,650 ft. (B. & F. 666 !).—N. of Dossali Fort, stony plain (B. & F. 1005 ! 1005a !).—Spinwam, on hill (B. & F. 448 !).—E. of Miram Shah, hills (F. 1386 !).
Distribution: Kuram Valley, Jhelum Valley, 3,000 ft.

Statice sp.
Locality: *S.W.*: In the upper regions (Stewart).

*Armeria L.

60 species.—N. temperate and Andine.

***Armeria vulgaris** Willd. Enum. Hort. Berol. 333.—*A. maritima* Willd. l.c.
Vernacular name: Common Thrift or Sea Pink.
Locality: *S.W.*: Razmak, in garden (B. & F.).
Flowers: April.
Distribution: Europe and America, along the seacoast.

PRIMULACEAE.

550 species.—Cosmopolitan, but especially N. temperate.

Primula L.

220 species.—N. hemisphere, chiefly in hilly districts.

Primula denticulata Sm. Exot. Bot. ii (1805) 109, t. 114.

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Locality: *S.W.*: Sirdar near Razmak, below Shuidar (Dundas 64 !).
Flowers: 20-3-30 (Sirdar).
Distribution: Temperate Himalaya, from Kashmir to Bhutan, 7,000-13,000 ft., Khasia Hills, 5,000 ft., Afghanistan.

Primula adenophora Blatter *sp. nov.* [*Primulacea pertinens ad sectionem capitatarum Pax similis est Primulae denticulatae Smith sed differt foliis cum floribus nascentibus, foliis spathulatis, scapo glanduloso-pubescenti, bracteis ovato-triangularibus brevioribus pedicellis flavo-farinosis et glandulosis corollae tubo multo breviore.*]

Herba ad 10 cm. alta. Folia cum floribus coatanea 9 cm. longa 2 cm. lata spathulata obtusa vel subacuta argute denticulata in petiolum latum alatum a lamina non discretum sensim attenuata nervis validis prominentibus stramineis infra parcissime farinosa et parce speciatim secus nervos pubescentia supra sparsim pubescentia. Scapus validus rigidus folia superans 8.5 cm. longus et 2 mm. diametiens capitulum multiflorum densissimum gerenus, brevissime glanduloso-pubescens speciatim in parte superiore, versus apicem dense albofarinosus et squamis stellatis cooperatus. Bracteae ovato-triangulares apice obtusae ad 5 mm. longae et 3 mm. latae ad basin, parcissime farinosae, margine et dorso glandulis brevissimis parce ornatae. Pedicelli 1-5 mm. longi, dense flavo-farinosi, brevissime glandulosi. Calyx 8 mm. longus tubuloso-campanulatus; segmenta tubo-aequilonga anguste lanceolata subacuta viridi-nigrescentia, marginae parce glandulosa. Corolla parce glandulosa, tubus 10 mm. longus extus flavus, limbus lilacinus fauce flavus 13 mm. diametiens, lobi obcordati profunde emarginati. Ovarium globosum. Stylus cum stigmate filamentis subbrevior. Filamenta antheris multo longiora. Fructum non vidi.

A herb up to 10 cm. high. Leaves appearing with the flowers, 9 cm. long 2 cm. broad, spathulate, obtuse or subacute, sharply denticulate, narrowed slowly into a winged broad petiole, with strong broad prominent straw-coloured nerves, on the back very sparingly farinose and sparingly pubescent especially along the nerves, on the ventral side slightly pubescent. Scape stout, rigid, longer than the leaves, 8.5 cm. long and 2 mm. diam., carrying a big, dense, many-flowered head, glandular-pubescent especially in the upper part, towards the apex densely white-farinose and sparingly covered with stellate scales. Bracts ovate-triangular, obtuse, up to 5 mm. long and 3 mm. broad at the base, very sparingly farinose, on the margin and back with a very few short glands. Pedicels 1-5 mm. long, densely farinose, with short glandular hairs. Calyx 8 mm. long, tubular-campanulate; segments as long as the tube, narrowly lanceolate, subacute, green blackish, sparingly glandular on the margin. Corolla sparingly glandular; tube 10 mm. long, outside yellow; limb lilac, throat with a yellow rim, 13 mm. diam.; lobes obcordate, deeply emarginate. Ovary globose; style with stigma slightly shorter than the filaments. Filaments much longer than the anthers. Fruit not seen.

Locality: *S.W.*: Razmak, 7,000 ft., shady gulleys on damp rocks (D. G. Lowndes L4 ! type, L4a ! cotype).
Flowers: February to March 1932.
Uses: Bulbs edible according to local information (Lowndes).

Primula Schlagintweitiana Pax in Engl. Pflanzenr. iv, 237 (1905) 91.
Locality: *S.W.*: On moist rocks E. of Razmak Camp (B. & F. 1953 !)
Flowers: 28-4-30 (Razmak).
Distribution: W. Himalaya, Kashmir, Kumaon, up to 13,000 ft.

Primula erosa Wall. Cat. (1828) 611.
Locality: *S.W.*: N. of Razmak, below Springs, 7,700 ft. (B. & F. 1815 ! 1816 ! 1817 !).
Flowers: 25-4-30 (Razmak).
Distribution: W. Himalaya.

Primula sp.
Locality: *S.W.*: (Duthie's Collect. 15602 !).

ANDROSACE (Tourn.) L.

84 species.—N. temperate (tufted xerophytes).

Androsace rotundifolia Hardw. in Asiat. Res. vi (1799). 350.

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Locality: *S.W.*: Kaniguram, 6,500 ft. (Duthie's Collect. 15772 !).
Flowers: 13-5-95 (Kaniguram).
Distribution: Temperate Himalaya, 5,000-11,000 ft., from Kashmir to Kumaon.

Androsace rotundifolia var. pusilla Kunth in Engl. Pflanzenr. iv, 237 (1905) 178.
Locality: *N.W.*: Razmak Narai, 7,250 ft. (B. & F. 1218 ! 1221 !).
S.W.: E. of Razmak, on hill, 6,800 ft. (F. 3103 ! 3106 !), on grassy ground (B. & F. 1946 !).
Flowers & Fruit: 14-4-30 (Razmak Narai); 24-4-30, 5-5-27 (Razmak).
Distribution: W. Himalaya, Afghanistan.

Androsace rotundifolia Hardw. **var. incisa** Kunth in Engl. Pflanzenr. iv, 237 (1905) 177.—*A. incisa* Wall. in Roxb. Fl. Ind. ed. Carey (1824) 16.
Locality: *S.W.*: Near Kaniguram brook (Stewart).
Distribution of var.: W. Himalaya, from Kashmir, Hazara, Afghanistan.

ANAGALLIS (Tourn.) L.

25 species.—Europe, Asia, Africa, S. America.

Anagallis arvensis L. Sp. Pl. (1753) 148.
Locality: *S.W.*: Barwand, 4,000 ft., on level stony plain (Duthie's Collect. 15714 !).
Flowers: 26-4-1895 (Barwand).
Distribution: More or less throughout India, Europe, W. Asia and introduced into most temperate regions.

Anagallis arvensis var. latifolia Lange Pug. (1865) 221.
Locality: *N.W.*: Near Chasmai River, 3 miles from Miram Shah, in cultivated field, 3,150 ft. (B. & F. 325 !).
Flowers & Fruit: 24-3-30 (Chasmai River).
Distribution: S. and N.W. Mediterranean, eastwards to Persia.

SAMOLUS (Tourn.) L.

10 species.—Cosmopolitan, especially S. hemisphere.

Samolus Valerandi L. Sp. Pl. (1753) 243.
Vernacular name: Aukovanna, Aparyara.
Locality: *N.W.*: Dwa Warkha (Stewart).
S.W.: Pre Ghal (J. Williams 7867 !).
Tank: (J. Williams !).
Flowers: 1-5-1891 (Tank).
Fruit: 1-8-1888 (Pre Ghal).
Distribution: Baluchistan, Afghanistan, Persia, Persian Baluchistan. Most temperate regions.

SAPOTACEAE.

600 species.—Tropics.

MONOTHECA A. DC.

(*Reptonia* A. DC.).

1 species.—From India to Muscat.

Monotheca buxifolia Dene. *ex observ. facta a cl. Boissiero sub descript. generis Reptoniae in sua Fl. Or.* iv (1879) 32.—*Reptonia buxifolia* A. DC. in DC. Prodr. viii (1844) 153.
Quoad Monothecam Mascatensem A. DC. *vide quod Boissierus l.c.* 33 *observat*: *Reptonia buxifolia Monothecam Mascatensem omnino refert et ab ea ex cl. Decaisne specifice non differt. Hac ratione inductus tamquam synonymum subjungo*: *Monotheca Mascatensis* A. DC. in DC. Prodr. viii, 152.
Vernacular name: Gurgura (Pu., Waziri).
Locality: *N.W.*: N.-E. of Razmak, Siroba (Stewart).—Above Dossali, 5,050 ft. (B. & F. 1097 ! 1101 !).—Razani (F. 2974 !).—W. of Miram Shah Fort, stony plain and hillside, 3,150-3,200 ft. (B. & F. 11 !).—Hills E. of

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Miram Shah Fort (B. & F. 530 !).—Datta Khel (F. 1238 ! 1240 !).—Boya (F. 1461 !).

S.W.: Sararogha (F. 149 ! 221 !).—Above Palosina (Stewart).—Near Anai above Palosina (Stewart).—Barwand, 4,000 ft. (Duthie's Collect. 15717 !).—Jandola (F. 263 !).—Wana, on hills (F. 3882 !).—Sarwekai (F. 3703 !).—Dargai (F. 3720 !).

Tank: (J. Williams !).

Flowers: 29-3-30 (Miram Shah); 12-4-30 (Dossali); 26-4-1895, May (Barwand); 22-6-27 (Sarwekai).

Fruit: 26-4-1895 (Barwand); 25-5-27 (Jandola).

Distribution: Punjab, Baluchistan, Afghanistan, Muscat in Arabia.

Uses: Fruit eaten.

OLEACEAE.

400 species.—Tropical and warm temperate regions, especially E. Indies.

Jasminum (Tourn.) L.

170 species.—Tropics and subtropics.

Jasminum humile L. Sp. Pl. (1753) 7.—*J. revolutum* Sims in Bot. Mag. t. 1731.

Vernacular name: Gadanghgava (Waziri).

Locality: *S.W.*: Near Kaniguram, about 6,500 ft., occasional (Stewart).—Pre Ghal (Duthie's Collect. 15621 !).—Hill E. of Razmak, 6,800 ft. (B. & F. 1881 ! 1891 !).

Flowers: May, 15-5-1895 (Pre Ghal).

Distribution: Himalaya, 4,000-10,000 ft., to Nepal, Bhutan, S. India, Ceylon, Salt Range, Baluchistan, Afghanistan.

Jasminum officinale L. Sp. Pl. (1753) 7.

Vernacular name: Shung (Waziri).

Locality: *S.W.*: Near Kaniguram, about 8,200 ft., (Stewart).—Hill E. of Razmak, 6,800 ft. (B. & F. 1892 !).

Flowers: May.

Distribution: Himalaya, 3,000-9,000 ft., Trans-Indus.

Jasminum grandiflorum L. Sp. Pl. ed. 2 (1762) 9.

Locality: *N.W.*: Miram Shah (F. 3370 !).

S.W.: Sur Duar Hills (Dundas 737a !).—Razmak, 6,300 ft. (F. 1761 ! 1810 ! 1821 !, B. & F. 1879 !).

Flowers: 27-6-30 (Sur Dar Hills).

Jasminum sp.

Locality: *N.W.*: Miram Shah (B. & F. !).

Syringa L.

10 species.—Europe, Asia.

Syringa persica L. Sp. Pl. 9; Boiss. Fl. Or. iv (1879) 38; Stewart Punj. Pl. (1869) 141; Aitchis. Fl. Kuram Valley (1880) 78; Brandis Ind. Trees (1911) 445.

Locality: *S.W.*: Razmak, on open stony ground, 6,500 ft. (F. 2377 ! 2390 ! 3019 !).—N. of Razmak, 7,700 ft. (B. & F. 1846 !).

Flowers: 25-4-30, 2-5-27 (Razmak).

Distribution: Persia, Caucasus.

Syringa sp.

Locality: *S.W.*: Upper regions (Stewart).

Fraxinus Tourn. ex L.

60 species.—N. hemisphere, especially N. America, E. Asia and Mediterranean.

Fraxinus xanthoxyloides Wall. Cat. (1828) 2833.

Vernacular name: Shung (Waziri).

Locality: *S.W.*: Kaniguram (Stewart).—Razmak (F. 3328 ! 3330 !).

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Distribution: N.-W. Himalaya 3,000-9,000 ft., Baluchistan, Afghanistan, Trans-Indus.

Fraxinus sogdiana Bunge Pl. Lehm. 390; Boiss. Fl. Or. iv, 41.—*F. oxycarpa var. sogdiana* Wenzig. in Engler's Bot. Jahrb. iv (1883) 176.
Vernacular name: Shineae (Waziri).
Locality: *N.W.*: Above Dossali Fort, bed of Khunai River, 5,000 ft. (B. & F. 1140 ! 1141 !).—N. of Dossali Fort, in nala called Rosh, 4,900 ft. (B. & F. 1016 !).
Flowers: 12-4-30 (Dossali).
Distribution: Turkestan.

Fraxinus potamophila Herd. in Regel & Herder Enum. pl. Semen. no. 698.—*F. Reqelii* Dippel Laubhozk. i (1889) 97.
Vernacular name: Shung (Waziri).
Locality: *S.W.*: Razmak (F. 2035 !).
Distribution: Lycia, Armenia, Persia, Turkestan.

Olea (Tourn.) L.

35 species.—Mediterranean, Africa, Indo-Malaya, Australia, New Zealand, Polynesia.

Olea cuspidata Wall. Cat. (1828) no. 2817.—*O. europaea* L. *var. cuspidata* Wall.; Stewart Punj. Pl. (1869) 139.
Vernacular name: Shwavan (Waziri), Kau.
Locality: *N.W.*: Razani, common, 5,000 ft. (F. 2157 ! 2838 !, B. & F. 68 !).—Boya (F. 1060 !).—Miram Shah (F. 800 ! 1453 !).—W. of Spinwam Fort, on Chota Darweshta, 3,000-4,800 ft. (B. & F. 744 !).—N. of Dossali Fort, stony plain, 4,900 ft. (B. & F. 1000 !).
S.W.: Wana, on hills N.-E. of Fort, 4,500 ft. (F. 3407 ! 3415 ! 3427 ! 3884 !).—Sarwekai, on hills, about 3,600 ft. (F. 3985 ! 3986 ! 3991 ! 4010 !).—Razmak, common on the hill ranges, about 6,800 ft. (F. 3105 ! 3338 ! 3340 ! 3349 !).—Sararogha (F. 42 ! 49 !).
Tank: Sheikh Badin near Tank (J. Williams 7868 !).
Flowers: 18-5-27, June (Sararogha).
Distribution: N.-W. India, Punjab, Nepal, Sind, Baluchistan, Afghanistan.

Olea europaea L. Sp. Pl. 8.
Vernacular name: Khwan (Pu.).
Locality: *N.W.*: Razani (Stewart), Siroba (Stewart).
S.W.: Above Palosina common on the lower hills (Stewart).—Near Anai above Palosina (Stewart).—N. of Doboi, about 5,000 ft., on a feeder of the Zam (Stewart).—Wide shingle plateau of Tandachina (Stewart).
Distribution: Mediterranean, Nubia, Orient.

SALVADORACEAE.

8 species.—Asia, Africa.

Salvadora Garcin ex L.

2 species.—W. Asia, Africa.

Salvadora oleoides Dcne. in Jacq. Voy. Bot. (1844) 140, t. 144.
Vernacular name: Plewan (Pu.); Pilu (Hind.); Jal.
Locality: *S.W.*: Above Khirgi (Stewart).—Jandola (F. 4097 !).
Tank: (Stewart, J. Williams 7170 !), common in many places along the frontier (Stewart).
Flowers: April 1860, 4-5-1888 (Tank).
Distribution: Punjab, Sind, Baluchistan, Arabia.
Uses: 'Its fruit is held by the inhabitants to be a great provocative of sexual crimes, but the chances are that its supposed effects arise less from any aphrodisiac qualities than from the opportunities afforded when parties of both sexes go out from the villages to gather the ripe fruit.' (Stewart).—Leaves used in dyspepsia. Fruit eaten (Williams).

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APOCYNACEAE.

1,400 species.—Mostly tropical, a few temperate.

Rhazya Dene.

2 species.—W. Asia.

Rhazya stricta Dene. in Ann. Nat. Sc. ser. 2, iv, 81.
Vernacular name: Ganderai (Waziri).
Locality: *N.W.*: In the lower regions (Stewart).—Stony ground at foot of nearest hill E. of Spinwam Fort, 2,600 ft. (B. & F. 447 ! 652 ! 757 !).
Flowers: 1-4-30, 3-4-30 (Spinwam).
Fruit: 1-4-30 (Spinwam).
Distribution: Punjab, Salt Range, Sind, Baluchistan, Afghanistan, Arabia.

*Vinca L.

5 species.—Europe, W. Asia.

***Vinca minor** L. **var. atropurpurea compacta** Hort.
Vernacular name: Common Periwinkle.
Locality: *N.W.*: Miram Shah, 3,100 ft. (B. & F. 523 !).
Flowers: 28-3-30 (Miram Shah).
Distribution: Europe.

Nerium L.

3 species.—Mediterranean to Japan.

Nerium odorum Soland in Hort. Kew. ed. 1, i (1789) 297.
Vernacular name: Ganderai (Mashudi).
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15654 !).—Razani (F. 2055 ! 2057 !).
S.W.: Between Sararogha and Razmak, Marabi torrent bed (F. 1531 ! 1533 ! 1534 ! 1539 !).
Flowers: 30-4-1895 (Shakai); 24-6-27 (Marabi).
Distribution: Himalaya up to 5,000 ft., Punjab, Salt Range, Trans-Indus, Baluchistan, Afghanistan, Persia.

ASCLEPIADACEAE.

1,700 species.—Mostly tropics, especially Africa, but a few temperate.

Hemidesmus R. Br.

1 species.—India.

Hemidesmus indicus R. Br. in Mem. Wern. Soc. i (1811) 57.
Locality: *N.W.*: W. of Spinwam Fort, Chota Darweshta, 2,750-3,000 ft. (B. & F. 714 !).
Distribution: N. Provinces of India, Abu, Ceylon.

Periploca Tourn. ex L.

12 species.—Temperate regions of Old World, tropical Africa.

Periploca aphylla Dene. in Jacq. Voy. Bot. (1844) 109, t. 116.
Vernacular name: Barrarra (Pu.), Baradha (Waziri), Barad (Bettani tribe).
Locality: *N.W.*: Miram Shah, on hills and plain, 3,600 ft. and upwards (B. & F. 13 ! 553 !).—Chota Darweshta, on boulder-strewn slopes, 3,000-4,800 ft. (B. & F. 741 !).—Dariawasti near Datta Khel (B. & F. 1643 !).—Near Shewa Post, left bank of Volam River, very common (B. & F. 893 !).—Datta Khel (F. 1329 ! 1339 !).—Boya (F. 557 ! 568 ! 899 !).—Razani, rare (F. 2083 !, Stewart).
S.W.: Near Palosina, common (Stewart).—Barwand (Duthie's Collect. 15715 !).—Sararogha (F. 155 ! 605 ! 621 !).—Jandola (F. 267 ! 4105 !).—Sarwekai, common (F. 3989 !).—Dargai Post (F. 3718 ! 3719 !).—Tenai Post (F. 3791 !).—Spin (F. 3826 !).—Wana (F. 3409 ! 3871 !).

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Flowers: 29-3-30 (Miram Shah); 2-4-30 (Chota Darweshta); 5-4-30 (Shewa Post); 8-4-27 (Boya); 19-4-30 (Dariawasti); 26-4-1895 (Barwand); 18-6-27 (Wana).
Fruit: 22-6-27 (Dargai).
Distribution: Punjab, Sind, Baluchistan, Afghanistan, Persia, Arabia, Nubia.
Uses: Tender shoots eaten by donkeys and goats. Used to increase flow of milk in cattle.

Glossonema Dcne.

6 species.—Tropical Africa and Asia.

Glossonema varians Benth. in Benth. & Hook. f. Gen. Pl. ii (1876) 748.
Vernacular name: Mangartevna (Waziri).
Locality: *N.W.*: 2 miles above Dossali Fort, bed of Khunai River, 5,050 ft. (B. & F. 1137 !).—Razani (F. 2948 ! 2959 !).—Razmak Narai, stony slope of ravine, 6,650 ft. (B. & F. 1225 ! 1257 !).
S.W.: Razmak, small plants scattered all over (F. 2361 !).—N. of Razmak towards Springs, 6,750-7,300 ft. (B. & F. 1760 ! 1941 ! 1949 !).
Flowers: 12-4-30 (Dossali); 14-4-30 (Razmak Narai); 5-5-27 (Razmak).
Fruit: Fruit of previous year still found on 5-5-27 at Razmak.
Distribution: Sind, Baluchistan, Persia.

Calotropis R. Br.

3 species.—Tropical Asia, Africa.

Calotropis procera R. Br. in Ait. Hort. Kew. ed. 2, ii, 78.
Vernacular name: Spulmei, Spelmei (Pu., Waziri).
Locality: *N.W.*: Miram Shah, on stony plain (F. 471 ! 882 !).—Dwa Warkha (Stewart).
S.W.: Zam Valley above Khirgi N.-W. of Tank, frequent in the shingly bed of river (Stewart).—Sararogha (F. 39 ! 48 !).—Jandola, open stony ground and nalas (F. 653 !).—Sarwekai (F. 3917 !).—Dargai Post (F. 3732 !).—Spin, scattered all over stony plain (F. 3841 !).
Flowers: 16-4-27 (Miram Shah); 18-5-27 (Sararogha); 24-5-27 (Jandola); 21-6-27 (Spin).
Distribution: Hot and drier parts of India, from the Punjab and Sind to W. and Central India, Baluchistan, Afghanistan, Persia, Arabia to Egypt and tropical Africa.

Pentatropis R. Br.

8 species.—Palaeotropics.

Pentatropis spiralis Dcne. in Ann. Sc. Nat. ser. 2, ix (1838) 327, t. 11.—*P. cynanchoides* R. Br. in Salt Voy. Abyss. (1814) App. p. 64.
Locality: *N.W.*: E. of Spinwam, stony sandy nala, 2,650 ft. (B. & F. 676 !).
Distribution: Punjab, Baluchistan, Afghanistan, Arabia, tropical Africa.

Pentatropis microphylla W. & A. in Wight Contrib. (1834) 52.
Locality: *N.W.*: In the lower regions (Stewart).
Distribution: India, Ceylon.

Vincetoxicum Rupp.

40 species.—Warm countries.

Vincetoxicum officinale Mönch Meth. (1794) 317.—*Cynanchum vincetoxicum* (L.) R. Br. in Mém. Wern. Soc. i, 47.—*Asclepias Vincetoxicum* L. Sp. Pl. (1753) 216.
Locality: *S.W.*: Kaniguram (Duthie's Collect. 15766 !).
Flowers: 13-5-1895 (Kaniguram).
Distribution: Temperate Himalaya, Kashmir to Sikkim, 7,000-11,000 ft., westwards to Europe.

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GYMNEMA R. Br.

40 species.—W. Africa to Australia.

Gymnema sylvestre R. Br. in Mém. Wern. Soc. i (1811) 33.
Locality: *S.W.*: E. of Razmak, on hill, 6,800 ft. (B. & F. 1886 !).
Flowers: 26-4-30 (Razmak).
Distribution: W. India, Ceylon, tropical Africa.

LEPTADENIA R. Br.

15 species.—Tropical Africa, Asia.

Leptadenia pyrotechnica (Forsk.) Dene. in Ann. Sc. Nat. (1838) 269.—*L. spartium* Wight Contrib. (1834) 48.
Vernacular name: Movung (Waziri).
Locality: *N.W.*: Boya (F. 1427 ! 1440 !).—Miram Shah (F. 1401 !).—E. of Spinwam Fort, sandstone ridge, 2,800 ft. (B. & F. 800 !).
Flowers: 27-3-27 (Boya); 14-4-27 (Miram Shah).
Distribution: Punjab, Rajputana Desert, Baluchistan, Arabia, Egypt, tropical Africa.
Uses: Plant is dried and burnt and ground and mixed with tobacco, and used as intoxicant (F.).

ORTHANTHERA Wight.

4 species.—Africa, India.

Orthanthera viminea Wight Contrib. (1834) 48.
Vernacular name: Movung (Waziri).
Locality: *N.W.*: Razani (Stewart).—Boya (F. 1501 ! 1503 !).
Flowers: 8-4-27 (Boya).
Distribution: N.-W. India along the base of the Himalaya, 1,000-3,000 ft., from Peshawar to Oudh (See Parker, p. 353).

CARALLUMA R. Br.

60 species.—Mediterranean to East Indies.

Caralluma (*Boucerosia*) **tuberculata** N. E. Brown in Kew Bull. (1895) 264; Gravely & Mayuran. in Bull. Madras Govern. Museum, new series iv, pt. 1 (1931) 20.—*Boucerosia aucheriana* Hook. f. Fl. Brit. Ind. iv (1885) 78 (*non* Decaisne).
Vernacular name: Pavona (Waziri); Pamanai (Bettani tribe).
Locality: *N.W.*: Chota Darweshta, in the shade of boulders, 2,750-3,000 ft. (B. & F. 707 !).—Miram Shah, 3,100 ft. (B. & F. 6 !, F. 379 ! 4209 !).—Boya (F. 279 ! 1064 !)
S.W.: Palosina (Stewart).—Jandola (F. 239 !).—Wana (F. 3873 !).
Fruit: 2-4-30 (Chota Darweshta); 14-4-27 (Miram Shah).
Distribution: W. Punjab, Salt Range, Baluchistan, Afghanistan.
Uses: The leafless stems are intensely bitter and are regarded as stomachic by both Pathans and Punjabis (Stewart).
Note: Its Persian name, Panj-angusht (five fingers), is descriptive of its appearance (Stewart).

LOGANIACEAE.

550 species.—Tropics, a few warm temperate.

BUDDLEJA Houst.

90 species.—Tropics and subtropics.

Buddleja crispa Benth. Scroph. Ind. (1835) 43; Wall. Cat. 6404, Marquand in Kew Bull. (1930) 199.
Vernacular name: Khadvanai (Waziri).
Locality: *N.W.*: Shakai (Duthie's Collect. 15686 !).—Dossali, nala (B. & F. !).

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S.W.: Kaniguram, about 6,500 ft., frequent, also at 8,200 ft. (Stewart).—N.-E. of Razmak, common (Stewart).—N. of Razmak, 6,700-7,300 ft. (B. & F. 1751 ! 1872 !).—E. of Razmak, on hill (B. & F. 1947 !).

Flowers: April 1860 (Kaniguram, Razmak); 25-4-30 (Razmak); 30-4-1895 (Shakai).

Distribution: N.-W. Himalaya, Baluchistan, Afghanistan, Kuram Valley, Bhutan.

Buddleja crispa Benth. **var. ferruginea** Blatter *var. nov.* [*Ramuli, foliorum facies inferior et inflorescentia ferrugineo-tomentosa, facies foliorum superior cinereo-tomentosa.*]

Vernacular name: Speravona, Speravonie (Waziri).

Locality: *N.W.*: Razani (F. 2849 ! 2888 !).

S.W.: N. of Razmak, below Springs, 7,700 ft. (B. & F. 1876 !, F. 2565 ! 2801 ! 2815 !).—Razmak (F. 3132 !).

In bud: 25-4-30 (Razmak).

Flowers: 5-5-27 (Razmak).

Distribution: Waziristan.

GENTIANACEAE.

800 species.—Cosmopolitan.

Gentiana Tourn. ex L.

400 species.—Cosmopolitan, Africa excepted, chiefly alpine.

Gentiana Kaufmanniana Regel *et* Schmalh. in Acta Hort. Petrop. vi (1879), 331.

Locality: *S.W.*: Pre Ghal (J. Williams 7873 !).

Flowers: 8-8-1888 (Pre Ghal).

Distribution: Turkestan.

Uses: Used for bronchitis (Williams).

Gentiana Moorcroftiana Wall. Cat. 4390.

Locality: *S.W.*: Pre Ghal (Hay).

Flowers: September (Pre Ghal).

Distribution: W. Himalaya, 8,000-12,000 ft.

Gentiana Lowndesii Blatter in Journ. Bomb. Nat. Hist. Soc. xxxv (1932), 861.

Locality: *N.W.*: Alexandra Ridge, 7,800 ft. (Capt. D. G. Lowndes 2430 !).—Plentiful on open hill-tops, 7,500-8,500 ft.

Flowers: October 1931.

Swertia L.

90 species.—Cosmopolitan, except Africa.

Swertia cordata Wall. Cat. 4378.

Locality: *S.W.*: Pre Ghal (Hay).

Distribution: Temperate Himalaya, 4,000-12,000 ft. from Kashmir to Bhutan, abundant westwards, Khasia Mts. 3,000-5,000 ft.

CONVOLVULACEAE.

1,000 species.—Tropical and temperate regions.

Convolvulus (Tourn.) L.

180 species.—Temperate, a few tropical regions.

Convolvulus arvensis L. Sp. Pl. 153.

Vernacular name: Parvatiae (Waziri).

Locality: *N.W.*: Dwa Warkha (Stewart).—Datta Khel Fort, garden 4,600 ft. (B. & F. 1415 !).—Datta Khel village (B. & F. 1443 !).—Boya (F. 1015 ! 1033 ! 1159 !).—Miram Shah village (B. & F. 459 !, F. 293 !).—Razani (F. 2919 !).

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S.W.: Kaniguram (Stewart, Duthie's Collect. 15752 !).—N. of Razmak, below Springs (B. & F. 1874 !, F. 1895 ! 1966 !).—Sararogha (F. 28 !).—Dargai Post (F. 3753 ! 3773 !).

Flowers: 28-3-30 (Miram Shah village); 5-4-27 (Boya); 16-4-27 (Miram Shah village); 17-4-30 (Datta Khel); 25-4-30 (Razmak); 30-4-27 (Razmak); 6-5-27 (Razmak); 18-5-27 (Sararogha).

Distribution: Nearly all temperate and subtropical regions.

Convolvulus pluricaulis Chois. Convolv. Or. 95.

Locality: *S.W.*: Near Palosina (Stewart).

Tank: (Stewart).

Flowers: April 1860 (Tank, Palosina).

Distribution: Punjab Plain, Upper Gangetic Plain to Bihar and Chota Nagpur, Gujarat, Senegal.

Uses: Considered by the Punjabis as a 'cooling' vegetable (Stewart).

Convolvulus leiocalycinus Boiss. Diagn. ser. 1, vii, 28; Fl. Or. iv, 86.

Locality: *Tank*: Shaur Hill near Tank (J. Williams !).

Flowers: 25-3-1891 (Tank).

Distribution: Baluchistan, Persia.

Convolvulus lineatus L. Syst. ed. 10, 923; Led. Fl. Ross. iii, 90; Boiss. Fl. Or. iv, 98.

Locality: *S.W.*: Wana, 4,500 ft. (Duthie's Collect. 15671 !).

Flowers: 6-5-1895 (Wana).

Distribution: Baluchistan, Afghanistan, Orient, Asia Minor, Europe, N. Africa, Soongaria, Altai.

Convolvulus Aitchisonii C. B. Clarke in Journ. Linn. Soc. xix (1882) 179.

Locality: *N.W.*: N. of Dossali Fort, stony plain, 4,900 ft. (B. & F. 1010 ! 1079 ! 1263 ! 1264 !).—Rare.

Flowers: 15-4-30.

Distribution: Afghanistan.

Convolvulus erinaceus Ledeb. in Eichw. Casp.—Cauc. p. 3-11, t. 7.—*Convolvulus spinosus* Burm. Fl. Ind. 47, t. 19, fig. 4 (*non* Descr. *nec* Eichw.); Boiss. Fl. Or. iv, 87.

Locality: *S.W.*: (Duthie's Collect. 15740 !).

Distribution: Baluchistan, Afghanistan, Persia, Turkestan.

Convolvulus acanthocladus Boiss. Diagn. ser. 1, vii, 27.

Vernacular name: Khauckzie (Mashudi).

Locality: *S.W.*: Sarwekai, stony ground (F. 4458 !).

Fruit: 7-6-27 (Sarwekai).

Distribution: Persia.

Convolvulus rottlerianus Choisy Convolv. Orient. in Mém. Soc. Phys. Genève vi (1834) 477.

Locality: *S.W.*: Jandola (F. 4109 !).

Flowers & Fruit: 29-5-27 (Jandola).

Distribution: Deccan, Rajputana Desert, Baluchistan, Afghanistan.

Convolvulus pilosellaefolius Descr. in Lam. Encycl. iii, 551; Boiss. Fl. Or. iv, 103.

Locality: *N.W.*: Datta Khel, in a garden, 4,600 ft. (B. & F. 1405 !).

Distribution: Afghanistan, Persia, Mesopotamia.

Convolvulus microphyllus Sieb. ex Spreng. Syst. i (1825) 611.

Locality: *S.W.*: Dargai Post (F. 3771 !).

Distribution: Gujarat, Rajputana Desert, Sind, Baluchistan to Egypt and Nubia.

Evolvulus L.

90 species.—Tropics and subtropics.

Evolvulus alsinoides L. Sp. Pl. (1762) 392.

Locality: *N.W.*: 9 miles S. of Spinwam (B. & F. 694 !).

S.W.: Jandola, stony ground (F. 3892).

Flowers & Fruit: 1-4-30 (Spinwam); 3-6-27 (Jandola).

Distribution: Tropical and subtropical countries.

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Cressa L.

5 species.—Tropics and subtropics.

Cressa cretica L. Sp. Pl. (1753) 223.
Locality: *S.W.*: Shalkh (J. Williams 7180 !).—Wana (F. 3501 !).
Distribution: All warm regions.

SOLANACEAE.

1,500 species.—Tropical and temperate regions; chief centre Central and S. America.

Solanum (Tourn.) L.

1,225 species.—Tropical and temperate regions.

Solanum nigrum L. Sp. Pl. (1753) 186.
Locality: *N.W.*: N. of Miram Shah village, clay bank of irrigation channel, 3,150 ft. (B. & F. 454 !).—Hills east of Miram Shah Fort (B. & F. 555 !).—Near Miram Shah Fort, bank of Chasmai River, sandy clay (B. & F. 211 !).
Tank: (Stewart, J. Williams 7180 !).
Flowers: 28-3-30 (Miram Shah); April 1860 (Tank); 4-5-1888 (Tank).
Distribution: All temperate and tropical regions of the world.

Solanum gracilipes Dene. in Jacquem. Voy. Bot. 113, t. 119.
Locality: *N.W.*: Lower regions (Stewart).—W. of Spinwam Fort, boulder slope of Chota Darweshta, 2,650-3,000 ft. (B. & F. 696 ! 706 ! 743 !).
Flowers: 2-4-30 (Spinwam).
Distribution: Kuram Valley, Baluchistan, Punjab, Sind.

Solanum xanthocarpum Schrad. & Wendl. Sert. i (1795) 8, t. 2.
Vernacular name: Kolkondai, Madaginiae (Waziri).
Locality: *N.W.*: Razani (Stewart).—Boya, rare (F. 552 ! 1425 !).—Miram Shah, on stony ground, 3,000 ft. (F. 885 !).—Near Miram Shah Fort, bed of Chasmai River in gravel and sand (B. & F. 274 !).—Hills E. of Spinwam Fort, gravel (B. & F. 764 !).—Shewa Post, 2,100 ft. (B. & F. 869 !).
S.W.: Tenai, stony ground, not common (F. 4042).—Jandola, on dry banks of Tank River, 2,200 ft. (F. 779 ! 4108 ! 4418 !).—Sararogha, dry nala and dry stony slopes (F. 152 ! 608 !).—Spin, open stony plain (F. 354 !) —Sarwekai (F. 3921 ! 3950 !).
Flowers: April, May.
Fruit: April, May, June.
Distribution: Tropics of the Old World.

***Solanum tuberosum** L. Sp. Pl. 185.
Vernacular name: Potato.
Locality: *N.W.*: In the hills, above 5,000 ft. (B. & F.).
Distribution: Native of America.

*Lycopersicum Hill.

10 species.—South America.

***Lycopersicum esculentum** Mill. Gard. Dict. ed. 8 (1768) n. 2.
Locality: *N.W.*: Miram Shah Fort, cultivated (B. & F. !).
Distribution: Tropical America.

Withania Pauq.

5 species.—Palaeotropics, subtropics.

Withania coagulans Dunal in DC. Prodr. xiii, pt. 1, 685; Boiss. Fl. Or. iv (1879) 288.—*Puneeria coagulans* Stocks in Hook. Ic. t. 801; Wight Ic. 1616.
Vernacular name: Shapeanga (Waziri); Puniar called puniri or punir-bad (i.e. cheese herb) in Afghanistan.
Locality: *N.W.*: Miram Shah, open stony plain (F. 146 ! 431 ! 477 ! 510 ! 877 ! 879 ! 1450 !).—Boya, open stony plain, 4,000 ft. (F. 936 ! 1445 ! 1477 ! 1478 !), at foot of hill (F. 1444 !).—Datta Khel, open stony plain

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(F. 1290 ! 1291 ! 1292 ! 1942 !).—Near Datta Khel village, 4,600 ft. (B. & F. 1476 !).

S.W.: Wana, 4,500 ft., in open stony plain (F. 3429 ! 3438 ! 3439 ! 3448 ! 3449 ! 3554 ! 3556 ! 3589 ! 3629 ! 3696 ! 3890 !), on hillside F. 3682 !).—Palosina (Stewart).—Spin, open stony plain (F. 3550 ! 3833 ! 3854 ! 3863 !).—Jandola, open stony plain and in nalas 2,300 ft. (F. 262 ! 623 ! 724 ! 4115 !).—Sarwekai (F. 3908 ! 3909 !).—Sararogha, stony plain (F. 126 !). —Barwand (J. Williams).

Flowers: March, April.

Fruit: May, June.—Once in March found old fruits and new flowers on same plant.

Distribution: Afghanistan, Baluchistan, Kuram Valley, Punjab, Sind, Sutlej Valley, 3,300 ft.

Uses: Used against stomach trouble.

Withania somnifera Dunal in DC. Prodr. xiii, i, 453; Boiss. Fl. Or. iv (1879) 287.—*Physalis somnifera* Forsk. Fl. Aegypt.—Arab. (1775) lxiii no. 130 cvi, no. 133.

Locality: *S.W.*: Jandola, on open stony plain, 2,200 ft. (F. 627 ! 634 ! 4122 !), along Tank River (F. 701 ! 4189 !).

Flowers: May.

Fruit: May.

Distribution: Mediterranean region, tropical and S. Africa, Arabia, Persia, Baluchistan, Kuram Valley, Sind, Punjab, other parts of India.

Datura L.

15 species.—Tropical and warm temperate regions.

Datura Stramonium L. Sp. Pl. (1753) 179.

Vernacular name: Barbak (Waziri).

Locality: *N.W.*: Miram Shah, nalas and banks (F. 380 !).

S.W.: On way to Razmak (Stewart).—N. of Razmak Camp, below Springs, 7,700 ft. (B. & F. 1845 !).

Fruit of previous year found 25-4-30.

Distribution: Cosmopolitan.

Datura fastuosa L. Syst. Nat. ed. 10 (1759) 932.

Locality: *N.W.*: E. of Miram Shah Fort, rocky bank of Chasmai River, 3,100 ft. (B. & F. 228 ! 233 !).

S.W.: Jandola in stony ground, 2,200 ft. (F. 725 ! 744 !).—Sararogha (F. 256 !).

Flowers: 23-3-30, May (Chasmai River).

Distribution: Cosmopolitan in the tropics.

Datura alba Nees in Trans. Linn. Soc. xvii, 73.—*D. fastuosa* L. *var. alba* C. B. Clarke in Hook. f. Fl. Brit. Ind. 4 (1883) 213.

Locality: *Tank*: (J. Williams 7883 !).

Flowers: 23-5-1888 (Tank).

Distribution: India to China and Malaya, Philippines.

Datura Metel L. Sp. Pl. (1753) 179.

Locality: *S.W.*: Sararogha, in sheltered spots in ravine, rare, 4,000 ft. (F. 50 !).

Distribution: Kashmir, N.-W. Himalaya, S. Europe. Supposed to have originally spread from S. America.

Physochlaina G. Don.

5 species.—Central Asia.

Physochlaina praealta Hook. f. Bot. Mag. t. 4600, *in nota*.

Locality: *S.W.*: In the lower regions (Stewart).

Distribution: N. Kashmir, W. Tibet, Kashgar, Yarkand.

Hyoscyamus (Tourn.) L.

11 species.—N. Africa, Europe, Asia.

Hyoscyamus niger L. Sp. Pl. (1753) 179; Boiss. Fl. Or. iv (1879) 294.—*H. persicus* Boiss. & Buhse Enum. 158.

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Locality: *S.W.*: N. of Razmak Camp in torrent bed, 6,500 ft. (F. 1592 ! 1633 ! 2278 ! 2279 !).—Razmak (Stewart).—Kaniguram, 6,500 ft. (Duthie's Collect. 15742 !).—Slopes of Shuidar, 7,000-9,000 ft. (F. 1588 ! 1589 !).
Tank: Near Tank, Shaur Hill (J. Williams !).
Flowers & Fruit: 18-4-30 (Shuidar); May.
Distribution: Europe, W. & N. Asia, Persia, Caucasus, Transcaucasus, temperate W. Himalaya, 8,000-11,000 ft., from Kashmir to Garhwal.

Hyoscyamus muticus L. Mant. 45.—*H. insanus* Stocks in Hook. Kew Journ. iv, 178.
Locality: *N.W.*: Khajuri Post, right bank of Sua Algad, on gravel, 2,250 ft. (B. & F. 348 ! 377 !).—Hills about Datta Khel (Dundas 72 !).
S.W.: Wana, 4,500 ft. (Duthie's Collect. 15785 !).—Jandola, along Tank River (F. 702 !).
Flowers: 20-3-30 (Datta Khel); 26-3-30 (Khajuri); 7-5-1895 (Wana); 26-5-27 (Jandola).
Distribution: W. Punjab, Sind, Afghanistan to Egypt.

Hyoscyamus pusillus L. Sp. Pl. (1753) 258.
Locality: *N.W.*: E. of Spinwam Fort, sandstone nala, 2,650 ft. (B. & F. 662 !).
Fruit: 1-4-30 (Spinwam).
Distribution: Mediterranean, Orient to the Altai.

*Nicotiana L.

45 species.—America, Polynesia, 1 in Australia.

***Nicotiana Tabacum** L. Sp. Pl. (1753) 180.
Vernacular name: Tobacco Plant.
Locality: *N.W.*: Miram Shah (B. & F.).
Flowers: March (Miram Shah).
Distribution: Supposed to be a native of S. America, others say of Africa.

OROBANCHACEAE.

140 species.—Chiefly N. temperate regions of the Old World, a few American and tropical.

Orobanche (Tourn.) L.

90 species.—Temperate and subtropical regions.

Orobanche amethystea Thuillier Fl. Paris ed. 2, i (1797) 317, **var. hyrcana** G. Beck Monogr. Orob. (1890) 331.
Locality: *N.W.*: Near Miram Shah Fort, on bank of Chasmai River, in grass, 3,100 ft. (B. & F. 204 ! 230 ! 231 !).
Flowers: 23-3-30 (Chasmai).
Distribution of var.: N. Persia.

Orobanche sp.
Locality: *S.W.*: (Duthie's Collect. 15626 !).

LENTIBULARIACEAE.

250 species.—Cosmopolitan.

Utricularia L.

210 species.—Tropical and temperate regions.

Utricularia sp.—Flowers blue, large.
Locality: *S.W.*: Sur Dar Hills (Dundas !).
Flowers: 27-6-30.

(*To be continued*).

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THE PALM CIVETS OR 'TODDY CATS' OF THE GENERA *PARADOXURUS* AND *PAGUMA* INHABITING BRITISH INDIA.

BY

R. I. POCOCK, F.R.S.,

Unofficial Assistant of the British Museum (Natural History).

PART II.

(*With text-figures* 3 & 4).

(*Continued from page* 877 *of volume* xxxvi).

PARADOXURUS HERMAPHRODITUS NICTITANS, Taylor.

? *Paradoxurus leucopus*, Ogilby, *Zool. Journ.*, iv, p. 300, 1828.[1]

Paradoxurus nictitans, Taylor, *Journ. Bomb. Nat. Hist. Soc.*, vi, p. 429, 1891.

Locality of type: Kondmals, Orissa Division of S. Bengal.

Distribution: Southern Bengal.

The partial albinism of the typical example of *nictitans*, upon which Taylor established this 'species', has not the systematic value claimed for it; and Wroughton, without further inquiry, dismissed *nictitans* as a synonym of *niger*, the name he adopted for the Southern Indian form. But Taylor's specimens and one other that I have seen from Southern Bengal, present certain characters suggesting that they may prove to be racially separable from other Peninsular Indian forms; and, pending the collection of additional examples, I provisionally give *nictitans* the benefit of the doubt to prevent it being overlooked and to draw the attention of naturalists to the need of fresh material from that part of India. Its resemblances to *bondar*, described below, are unmistakable.

The Museum has three unmeasured, undated male skins from the typical locality, presented by Mr. J. H. Taylor and all affected by albinism. The type, immature, has only the head and shoulders normally coloured, the rest being white as shown by

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[1] This variety, based on a menagerie specimen without locality, will probably never be allocated. It is questionably inserted here because its partial albinism manifested by a white abdominal belt, white paws and end of the tail was similar to that of two of the three examples named *nictitans*. But it differed from the specimens I assign to the latter race in having the ground colour 'pale brown'.

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Mr. Taylor's plate. The others have a broad white belt encircling the hind body and extending forwards and backwards over the ventral surface; the feet and the terminal third or more of the tail are also white, but the extent of the white varies in the two. Since the mother of the type was said to resemble her offspring, all the examples recorded from Kondmals are partial albinos, suggesting the prevalence of albinism in that district; but probably these specimens were preserved merely because of that peculiarity. No doubt normaliy tinted individuals occur there also. Where the coat is pigmented it is very similar in tint in the three specimens, the ground tint varying from clear grey to slightly buffy grey, overlaid to a varying extent by long black-tipped hairs, but the tail is mainly grey, the black being little in evidence. The pattern is indefinite and superficial. The coat is good but varies in length and thickness. In the type, known to have been killed in December, and in one of the others it is thick and full, with more underwool than in average examples of typical *hermaphroditus*.

At Pareshnath in Hazaribagh, some 240 miles to the north of Kondmals, Crump secured, on June 14, an adult ♀ which I assign to this race. The coat is long and rather shaggy, the under hair is grey and the black-tipped hairs are tolerably abundant. No pattern is traceable. Wroughton consequently identified the specimen as *crossi* which he said was bigger than *niger;* but this specimen is decidedly smaller, as the table of measurements shows.

	In English Inches.				In Millim.	
Locality, date and Sex	Head and Body	Tail	Hind foot	Weight	Wool	Hair
Kondmals, Orissa (type). Dec.; young ♂	20	18	...	...	26	45
Kondmals, Orissa; ? date; just ad. ♂	...	...	...	...	26	39
,, ,, ,, ,, ♂	...	...	...	...	31	51
Hazaribagh; June 14; ad. ♀ ...	18¾	19⅛	3	3 lbs.	37	57

The body and tail measurements of the type were recorded by Mr. Taylor in his paper at the time of the animal's death. As a made-up skin it is nearly as large as the other two males, of which the dimensions were not taken.

The difference in the length of the coat of the type and of the example from Hazaribagh is considerable, but is probably to be explained by the coat not having attained its full length by

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December in the type, whereas the Hazaribagh specimen was no doubt still carrying its winter coat in June.

The following are the measurements of the few available skulls:

	In English Inches.					In Millimetres.		
Locality and Sex	Total length	Zygom. width	Waist width	Int. orb. width	Max. width	Bulla	Pm^1	M^1
Kondamals, Orissa; just ad. ♂ ...	4·1½	2·2½	·4½	·7	·7	15	7½ × 5½	5 × 7
Kondamals, Orissa; just ad. ♂ ...	4·0	2·1	·5	·7–	·7	15	7 × 5	5 × 6½
Kondamals, Orissa (type) young ♂...	3·7½	1·8½	·5½–	·6½	·6	14	6 × 5	5 × 7
Hazaribagh ; ad. ♀	3·6½+	1·9+	·4½	·6	·6	14½	8 × 6	5 × 7½

The first skull on this list has apparently attained practically its total length. It has a long and narrow 'waist', with the temporal crests diverging far in advance of its narrowest point and

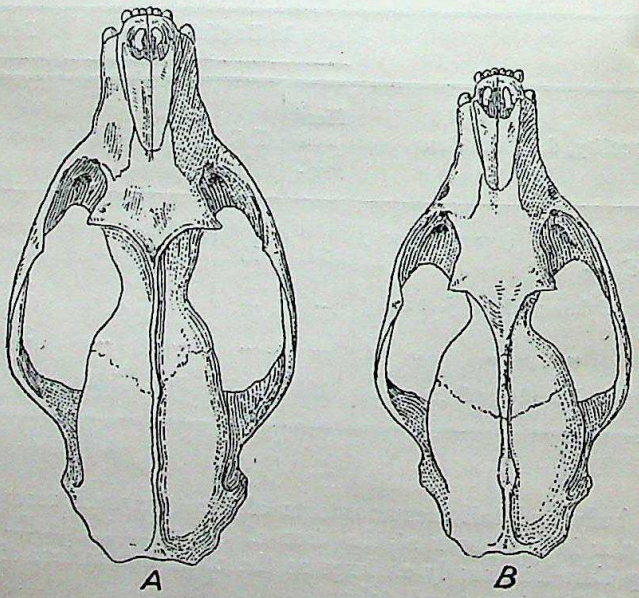

Fig. 3.—*A*. Skull of just adult male of *P. h. nictitans* from Kondamals, Orissa. *B*. The skull of adult female assigned to this race, from Hazaribagh. Both 2/3 nat. size.

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forming behind a distinct but low sagittal crest, thick over the frontals, narrow over the parietals; the postorbital processes are quite short. The second skull, judging from the sutures, appears to be about the same age, but in other respects looks younger, the sagittal crest being lower and thinner, the ridges divergent a little farther back, the 'waist' shorter and a trifle wider and the postorbital processes shorter, 21 mm. from tip to tip as compared with 25 mm. in the larger skull. The skull of the type, of which the tooth-change was described above (p. 174), is young. It has no sagittal crest, the temporal ridges being 5 mm. apart at the fronto-parietal suture and 8 in the middle of the parietals, the waist is wide but the postorbital processes from tip to tip are only 3 mm. narrower than in the largest skull. The largest skull is considerably smaller than the average size of male Indian skulls assigned to typical *hermaphroditus*, the nearest to it being the skull from Rorighat, Hoshangabad. It looks indeed like a female skull of that race. It must also be compared with a skull of a male collected by Crump at Singar in Gaya, some 300 miles to the north of Kondmals. This skull is a little larger, but considerably younger as shown by its more manifest sutures, lower, thinner sagittal crest and weaker divergent ridges on the frontals; the waist too is much shorter, and, despite the difference of age the postorbital processes are wider, 29 mm. as compared with 25 mm., and the frontals about half-way between the waist and the suture more salient and convex, 24 mm. instead of 20 mm. across. This skull indeed is much more like the skulls of typical *hermaphroditus, hirsutus* and *bondar* than is the ♂ skull of *nictitans*.

The female skull, assigned to *nictitans*, from Hazaribagh, some 250 miles north of Kondmals and geographically just south of Gaya, is evidently adult, there being hardly a trace of the sutures remaining, but it is considerably smaller than any adult female skulls of the other Indian races of *P. hermaphroditus*. The temporal ridges are weak and although almost meeting on the crown, they form hardly any saggital crest and become almost obsolete in front of their point of divergence a long way behind the 'waist'; the postorbital processes, as in the male skulls, are very short, only 19 mm. across. This skull is nearly the same size as the young female skull of *hermaphroditus* from Alnavar, Dharwar, entered in the table (vol. xxxvi, p. 874). But the latter is much younger, the temporal ridges being 7 mm. apart at the junction of the frontals and parietals and 10 mm. on the parietals where the vermiform suture between them is still very manifest; the postorbital processes also are much better developed, being 24 mm. from tip to tip. Judging by the sutures this Hazaribagh skull is as old as the ♀ skull of *bondar* from Rohilkand; but the latter is a much larger skull, with the sagittal crest slightly better developed, the divergent temporal ridges well defined in front of the waist and the postorbital processes 25 mm. from tip to tip. It is also noticeably smaller than the young ♀ skull from Darbanga which has the temporal crests wide apart.

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PARADOXURUS HERMAPHRODITUS SCINDIAE.[1] Subsp. nov.

Locality of type: Guna in Gwalior, about 40 miles N. of lat. 24°.

Distribution: Gwalior, Bhopal C.I., and probably Rajputana, i.e. the country drained by the Chambal and its tributaries, flowing N.E. into the Ganges.

Description: Distinguished from typical *hermaphroditus* of Southern India and Ceylon by its slightly larger size and, in winter, by its longer, more luxuriant coat, and less conspicuous black tips of the longer hairs. The pale ground colour varies from pure darker or lighter grey to slightly buffy grey, and owing to the length and fulness of the coat the pattern tends to be marbled or blotchy in type.

Several adult, subadult, and young specimens were collected for the Mammal Survey in various parts of Gwalior by J. Riley O'Brien. The recorded measurements of four of these from Guna (type), Binganj, Cachora Fort and Agar, are entered in the table below. There are, in addition, an unmeasured ♀ skin from Guna and four half-grown specimens from Binganj.

There are also in the Museum two unmeasured and unsexed skins, without skulls, collected in 1879 by Col. J. W. Yerbury at Neemuch (Nimach) about 140 miles W. of Guna. One, a ♂ judging from the skin, obtained at the Cantonment, 1,400 ft., in March, has the coat scanty but long, the general hue pale brown owing to the under hair, which is about 40 mm. being tawny, and the longer hairs, about 60 mm. blackish brown, as if faded, and the pattern is obscure and streaky. The other, obtained at Baval, near Neemuch, 1,500 ft., in April, has the coat of about the same length, but much fuller, and the general colour very different owing to the under hairs being clear grey and the long hairs normally black, forming a mottled pattern. Another skin ♀, of apparently the same race, was collected on April 29th, at Sehore in Bhopal, to the south of Gwalior, by Whitehead. The coat is thin and rather shaggy, as in the tawny example from Neemuch, but is about the same length; the general colour, however, is more like that of the example from Baval, but duskier owing to the deeper hue of the grey under hair. Sehore is only about 50 miles north of Hoshangabad, where the Palm Civets appear to be typical *hermaphroditus;* but the two places are separated by the Vindhya Range, Sehore being in the Chambal River system and Hoshangabad on the Narbada River. From the subjoined table of measurements it may be seen that the ♀ from Sehore, which may or may not be quite adult, there being no skull wherewith

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[1] At the suggestion of Mr. W. S. Millard this race is named after H. H. the late Maharaja Sir Madhowrao Scindia, G.C.S.H., G.C.V.O., of Gwalior, commonly known as Maharajah Scindia, one of the first subscribers to the fund which enabled the Natural History Society of Bombay to start work in the field for the Survey of the Mammals of British India.

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to settle the point, is larger than the adult males from Hoshangabad, and noticeably larger than the average size of females of *hermaphroditus*.

These three skins from Neemuch and Sehore, which were assigned by Wroughton to his imaginary species, *crossi*, are of some interest, because, collected in the spring, they retain some of the hairs of the full winter coat and indicate the length of coat O'Brien's specimens would have attained if they had lived till that time of the year.

I also assign to this race two skins, ♂ and ♀, collected on September 15th at Sambhar, Rajputana, by H. M. Adam and, like the examples from Neemuch and Sehore, identified by Wroughton as *crossi*. They are in poor coat, many of the longer hairs being shed; the general colour is dark grey, like the specimen from Sehore but with a slight tawny tint; the pattern is represented at most by indefinite lines. The body measurements of the female, an old animal, were lost with the original label. Those of the male, not quite full grown, are entered on the following table.

Locality, Date and Sex.	In English Inches.			In Millimetres.	
	Head and Body.	Tail.	Hind Foot.	Wool.	Hair.
Guna, 1,564′; Oct. 28, (type), yg. ad. ♂	26½	22⅛	3½	30	52
Binganj, 1,375′; Nov. 28, ad. ♀	26	24	3⅓	34	57
Cachora Fort, 1,681′; Nov. 18; ad. ♀	24⅘	22	3⅛	28	45
Agar Malwa; ? alt., Dec. 12; yg. ad. ♀	24⅗	20⅘	3	35	57
Sehore, Bhopal, 1,700′; Apr. 29, ? ad. ♀	23⅛	21⅛	3¼	40	62
Sambhar, Rajputana; Sept. 15; yg. ad. ♂	24⅜	23	3⅜	28	58

This table shows marked average superiority in the length of the head and body and of the tail over the examples assigned to *hermaphroditus*. The approximate average dimensions of the females of *scindiae*, for instance, are: head and body 24⅓ ins., tail 22 ins.; of *hermaphroditus*, head and body, 21½ ins., tail 20 ins. The hind feet are about the same length.

The measurements also attest average superiority in the length of the coat, at its best, in *scindiae*. By taking examples of the two races killed between and including December and April, before

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the winter coat is moulted, the average length of its two constituents can be estimated. In *scindiae* the approximate average of the 'wool' is 45 mm., of the long hairs 60 mm.; the corresponding measurements in *hermaphroditus* being about 30 mm. and 53 mm.

Skull-measurements are as follows:—

Locality and Sex	In English Inches					In Millimetres.		
	Total length	Zygom. width.	Waist. width.	Int. orb. width.	Max. width.	Bulla	Pm^4	M^1
Guna (type) yg. ad. ♂	4·5	2·4	·5	·7–	·8	16	8×6	5×7
Binganj. ad. ♀	4·4	2·4	·5–	·7½	·7+	16	8×6	5×7
Agar Malwa, yg. ad. ♀	4·2	2·2	·5	·7	·7	17	8×5½	5×7
Cachora Fort. ad. ♀	4·1	2·3	·5	·7½	·8–	15½	8×6	6×8
Guna. yg. ♀	4·0	2·1	·5	·6	·6⅛	15	7×5–	5×6½
Sambhar, Rajputana; yg. ad. ♂	4·4	2·3½	·5	·8–	·8	18	8¼×7	6+×8
Sambhar, Rajputana; old. ♀	4.1½	2·4	·4+	·7	·8–	17½	8×6½	5×7½

From the data supplied by this table it cannot be claimed that the skulls of this race are larger than those of typical *hermaphroditus* of Southern India, despite the superiority in the bodily dimensions. The skulls are similar and vary similarly in the two races. The difference in the size of the teeth between the females from Guna and Cachora Fort is very noticeable; and the difference, of course, has nothing to do with the difference of age.

Paradoxurus hermaphroditus laneus, subsp. nov.

Locality of type: Gopalpur, 5,200 ft., in Kangra.

Distribution: Kangra, in the Upper Punjab, from 2,000 ft. to 7,000 ft.

Nearly resembling *scindiae* from Gwalior in size and general appearance, but with the winter coat fuller, more woolly, perceptibly more resistant to the touch; the long hairs are not so extensively black terminally and there is more black on the sides of the neck.

Five adult and young adult examples collected in March by H. W. Wells for the Mammal Survey at Gopalpur in Kangra 5,200 ft. and 7,000 ft. and in the Kangra Valley 2,000 ft. to 2,500 ft. There is in addition a flat, undated, unsexed skin probably procured from a native.

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In the typical example, an oldish ♂ from Gopalpur, 5,200 ft., March 6 (collector's No. 2173), the colour is buffy grey and black in about equal proportions, the black forming a rather irregular pattern of lines and spots, somewhat mottled or marbled; the coat is luxuriant and upstanding, with the wool deep reaching almost as high as the summit of the pale area of the long hairs which, erected by it, do not conceal with their black tips the lower pale areas of the coat. The brow-band is not so conspicuous as in the rest of the specimens, being interrupted by black which reduces it to a pair of grey patches on the forehead and a grey patch above the posterior corner of each eye. A young ♂, with milk teeth, from Gopalpur, 7,000 ft., March 3 (No. 2166), is almost identical with the type in colour and pattern, but grey with no buff on the belly; the coat is beginning to come away on the rump. In most of the other specimens, taken at lower levels in the Kangra Valley, 2,000 to 2,500 ft., the coat is still luxuriant but shows signs of breaking with the moult, the dates of their capture being a fortnight or more later. One of them, a ♀ skin (No. 2253) is buffier grey than the type and has the pattern much less distinct. Another, a ♂ skin (No. 2211) has lost a lot of the black-tipped hairs on the rump, the wool remaining. Finally, the skin of an adult ♀, March 28 (No. 2285), apparently suckling young to judge from the size of the mammae and the nakedness of the surrounding skin, is in full moult, as recorded below. Apart from its size this skin is not distinguishable from skins of typical *hermaphroditus* similarly moulting.

The recorded flesh-measurements and weights are as follows:—

Locality, Date and Sex	Head and Body	Tail	Hind Foot	Weight	Wool	Hair
Gopalpur, Kangra, 5,200′ ; Mar. 6 ; ad. ♂	27½	24½	3⅜	9 lbs.	40	62
,, ,, 7,000′ ; Mar. 3, immat. ♂	22½	21⅜	3½	6 ,,	35	47
Kangra Valley, 2,000′ ; Mar. 26 ; yg. ad. ♂	26¾	25	3⅜	...	41	52
,, ,, ,, Mar. 21 ; ad. ♂	23½	22⅝	3⅜	...	40	60
,, ,, 2,500′ ; Mar. 25 ; ad. ♀	25½	24	3½	...	41	63
,, ,, 2,000′ ; Mar. 28 ; ad. ♀	26¾	25⅜	3⅜	...	...	...

The flesh-measurements here recorded agree tolerably closely with those of *scindiae*.

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To the skull measurements of *laneus* given below, are added those of the Kashmir race next described.

Locality and Sex	In English Inches: Total length	Zygom. width	Waist width	Int. orb. width	Max width	In Millimetres: Bulla	Pm^4	M^1
laneus								
Kangra, Gopalpur (type) ad. ♂	4·7	2·8	·5	·9½	·9	18	10 × 7	...
,, ,, immat. ♂	4·1	2·2	·5⅓	·7–	·7	16	...	...
,, Valley; yg. ad. ♂	4·7	2·6	·5+	·8	·7½	18½	9 × 7	...
,, ,, ad. ♂ (? ♀)	4·4⅓	2·4+	·5	·7½	·8–	18½	9 × 6	6 × 8½
,, ,, yg. ad. ♀ (? ♂)	4·6½	2·5	·5½	·8	·8–	19	9½ × 7	...
,, ,, ad. ♀	4·3½	2·3½	·5+	·8–	·7½	19	9 × 6	6 × 8
vellerosus								
Kashmir; yg. ad. ? ♂	4·9½	2·7⅓	·6	·9¼	·8½	20	9 × 7	6 × 7

In the list of the Kangra specimens the queries regarding the sex of the fourth and fifth skulls are explained below.

The first on the list, the type of *laneus*, is fully adult, rather old indeed judging from the worn teeth. It is well developed and similar to the skull of *hermaphroditus* from Bellary with the temporal ridges strong where they meet over the waist and running into a large sagittal crest, 8 mm. high, the postorbital processes wide and salient, 41 mm. from tip to tip, exceeding that dimension in any other Indian skull and the zygomatic arches at their level 65 mm. across. The third skull still has the basioccipital suture open and would probably have exceeded the type-skull when full grown. I believe, however, that the fourth and fifth skulls, respectively marked ♂ and ♀, have had their labels exchanged. The fourth (collector's No. 2211) is approximately as old as the type skull, but it has all the characters of a female skull and almost exactly matches the last on the list (No. 2285) which belongs to the ♀ skin in moult. It is comparatively small, with the temporal ridges weak over the waist, forming a crest from 1 to 2 mm. high on the frontals and separated on the parietals; the postorbital processes are only 30 mm. across and the zygomatic arches on a level

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with them only 54 mm. wide. The fifth skull, on the contrary, marked ♀ (No. 2253) almost exactly resembles the third on the

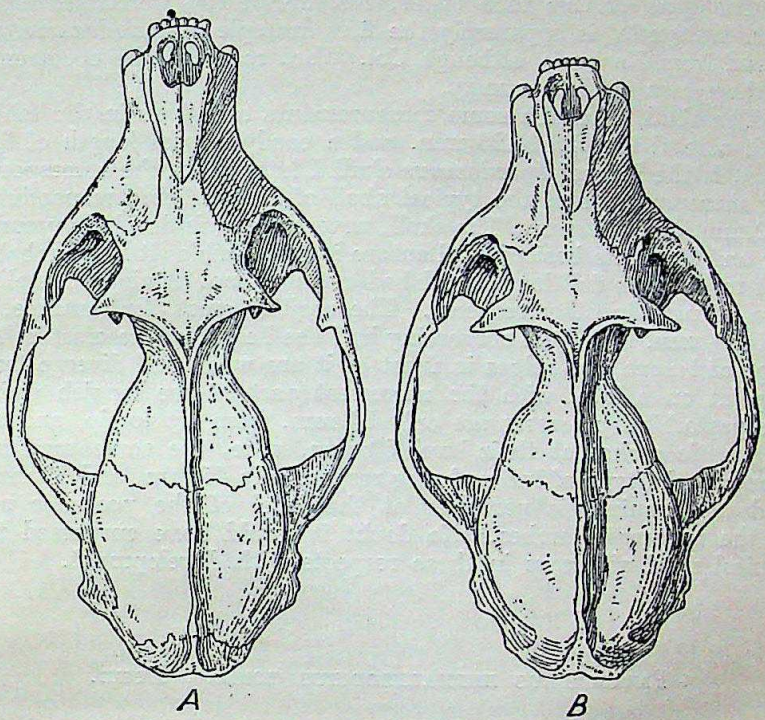

Fig. 4.—*A*. Skull of young adult male (type) of the Kashmir race (*P. h. vellerosus*. *B*. Fully adult male skull of the Kangra race (*P. h. laneus*). Figs. 2/3 nat. size.

list, a young adult ♂ (No. 2265), and would probably have exceeded the type in size when full grown.

The immature dimensions of the second skull on the list have been added to show the size with the milk teeth still functional and the permanent set, although ready to erupt, still beneath the gum.

Although the data are few and not very satisfactorily comparable, the measurements in this table attest slight superiority of the skulls of *laneus* over those of *scindiae* in all the dimensions cited, except the waist. The bullae and teeth are also a little bigger.

PARADOXURUS HERMAPHRODITUS VELLEROSUS, subsb. nov.

Locality of type and only known specimen: Kashmir.

Like the type of *laneus* from Gopalpur, 5,200 ft., in Kangra, in colour and pattern but with a larger skull and a better coat, the woolly under hair about 50 mm. long, the longer hairs about 60 mm.

On the made-up skin the tail measures 28 in.; on the similarly

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made-up skin of the type of *laneus* the tail is 25½ in., the head and body being about the same in the two specimens.

The type of this race (B.M. No. 23.9.1.17), purchased from Mrs. Entwistle, is apparently the first example of *Paradoxurus* received from Kashmir, although Col. Ward recorded the occurrence of the genus in that country.

The skull, of which some measurements are given in the table, with a total length of 125 mm. and a condylo-basal length of 122 mm., is the longest *Paradoxurus* skull I have seen, the corresponding measurements of the typical skull of *laneus* being respectively 119 mm. and 118 mm. The skull, nevertheless, is decidedly younger; and since the basioccipital suture is still visible, it had probably not reached its full length and had certainly not attained complete development in other respects. The sagittal crest, for instance, is only 4½ mm. high, just surpassing half the height of the crest in the type of *laneus*, the ridges in front of it are weak and diverge from a point on a level with the narrowest part of the longish waist, the postorbital processes are only 34 mm. from tip to tip, and the zygomatic arches at their level 60 mm. wide, the same measurements in the type of *laneus* being respectively 45 mm. and 65 mm., and the cranium is narrower at the level of the posterior root of the zygomatic arches. No doubt it would have surpassed the typical skull of *laneus* in those respects with development.

Paradoxurus hermaphroditus bondar, Desm.

Viverra bondar, Desmarest, *Mamm.*, p. 210, 1820.

Paradoxurus bondar, Gray, *Illustr. Ind. Zool.*, pl. xii, 1833; *id. Proc. Zool. Soc.* 1864, p. 531.

Paradoxurus pennantii, Gray, *Proc. Zool. Soc.* 1832, p. 66; *id. Illustr. Ind. Zool.*, pl. xiii, 1833.

Paradoxurus crossi, Gray, *Proc. Zool. Soc.* 1832, p. 67; *id. Illustr. Ind. Zool.*, pl. vii, 1833.

Paradoxurus hirsutus, Hodgson, *Asiat. Res.*, xix, p. 72, 1836.

Paradoxurus strictus, Horsfield, *Ann. Mag. Nat. Hist.* (2), xvi, p. 105, 1855; id. *Proc. Zool. Soc.* 1856, p. 396, pl. 47.

Locality of type of *bondar*: Bengal.
Locality of type of *pennantii*: Higher Province of Bengal.
Locality of type of *crossi*: 'India'.
Locality of type of *hirsutus*: Nipalese Tarai.
Locality of type of *strictus*: Nepal Tarai.
Distribution: Rohilkund and 'the open parts of Nipalese Tarai and generally in British districts on the left (north) side of the Ganges to Northern Bihar' (Hodgson); Bengal (Desmarest).

Description: Closely resembling *scindiae* and *laneus* in the length and luxuriance of the winter coat, the under hair long and thick so that the longer black-tipped hairs are raised, not lying smoothly as in *hermaphroditus*; the pattern less pronounced than

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in *scindiae* and *laneus*, sometimes evanescent and when indicated formed by the confluence of the black tips of the longer hairs and therefore readily disarranged; general colour varying from nearly white to pale whitish grey with a faint buff tinge or to conspicuously 'yellow' or tawny.

This Survey only procured a few examples assigned to this race and there are only two, or possibly three, in Hodgson's collection.

I see no reason for dissenting from Gray's determination of Desmarest's *bondar*. Blanford, on the contrary, reversing Gray's decision, quoted *bondar* as a synonym of *niger*, although Desmarest's descriptions of the two emphatically attest their distinctness and the characters he assigned to *bondar* contradict the diagnosis of *niger* given by Blanford in his analytical key. According to Desmarest his description of *Viverra bondar* was taken from a sketch, sent to him by Blainville, which was alleged to be a copy of an unpublished coloured drawing seen by him in London of a specimen from Bengal named 'Ichneumon bondar'. The original painting, by Buchanan Hamilton, was in the possession of the East India Company. Blanford examined it, and without comparing it with Desmarest's description of *bondar*, came to the conclusion that it represented the South Indian Palm Civet (*niger*). I do not agree with that opinion, but the point is of no importance because Buchanan Hamilton's painting is not the type of *bondar* as Blanford claimed. The type is Blainville's alleged copy of it. I say 'alleged' because the original painting, still preserved at the India Office, where I was courteously allowed to see it, differs in several points from Desmarest's description of *bondar* and suggests that Blainville inaccurately copied it, possibly modified his drawing from a specimen in his possession which he identified as Buchanan Hamilton's 'bondar'.[1] For the determination of *bondar*, therefore, we are dependent upon Desmarest's description, which states that the coat is very thick and tawny in tint with the points of the longest hairs black, the pattern consisting of a median dorsal stripe continued all along the tail and of two narrow parallel bands extending along the flanks from the shoulders to the croup; the tail is black in its terminal third and below the eye there is a grey patch surrounded by black continuous with a black patch on the sides of the muzzle.

The type of *pennantii* was a coloured sketch by Hardwicke of a specimen from the Higher Province of Bengal which in those days extended westward to the frontier of Oudh, south of the Nepal Tarai. The reproduction of it in *Illustrations of Indian Zoology*

[1] Even more manifest are the discrepancies between Desmarest's description of *Viverra prehensilis*, which has the same history as *bondar*, and Buchanan Hamilton's original painting. According to the latter, for instance, only the basal third of the tail is the same colour as the rump and its tip is white. Desmarest's description of Blainville's alleged copy says the 'greater part' of the tail is the same colour as the body and the tip black. The identification of Desmarest's *prehensilis* is, however, of no particular importance, the name being preoccupied.

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represents the body and at least the proximal half of the tail as tolerably uniformly tawny buff with some darker streaks running over the flanks from the shoulders to the root of the tail. Gray himself, in his revision of 1864 dropped the name as a synonym of *bondar* and I accept that decision. By Blanford *pennantii*, without any apparent reason, was added to the synonymy of his *niger*.

The type of *crossi*, said to have come from India and exhibited in the Surrey Zoological Gardens, was drawn while still alive and the figure, reproduced in *Illustrations of Indian Zoology*, depicts the body as yellowish or buff all over without trace of definite pattern of lines or spots, and covered with a luxuriant, obviously woolly, coat. It unmistakably resembles Hodgson's unpublished drawings of his *hirsutus* and is quite unlike any specimens of Palm Civets I have seen from Southern India. But a skin in the British Museum, labelled as the type, is very different from the sketch. The coat is thick, but quite short and harsh, dirty whitish grey in hue superficially, although buffy beneath, and irregularly blotched with black. It similarly disagrees with Desmarest's description of *bondar*, with Gray's illustrations of the latter and of *pennantii*, and with Hodgson's description of *hirsutus*. In my opinion it cannot with confidence be regarded as the type of *crossi*, a belief which probably arose from its coming from the Surrey Zoological Gardens, which is of course unsatisfactory evidence. Blanford cited *crossi* as a synonym of *niger*, an opinion unsupported by Gray's original figure and by the alleged type specimen.

Hodgson described *hirsutus* as 'full clear yellow, largely tipped with black and entirely void of markings or lines (definite pattern), the brow band pale yellow, the long hairs free and erectile, not applied to the body and 2¼ ins. (57 mm.) long, and the yellow wool, greyish basally, more than half their length. This example was evidently in perfect coat. For this and other reasons it is impossible to accept Thomas's decision that one of Hodgson's originally unnamed examples in the British Museum is the type of *hirsutus*, for in this specimen (No. 43.1.12.119) the coat is in poor condition owing to the moult and, apart from the faint tawny tinge on the back, the pale areas of the long hairs, which are only about 43 mm. and scanty on the rump and flanks, are mostly pale grey and the distal portion of the wool, which is about 25 mm. deep is the same tint, as also is the brow-band, instead of yellow as in Hodgson's example. Moreover, the black tips of the long hairs form by their confluence an indistinct pattern. It would be impossible to guess the racial identity of this skin if its locality were unknown. By Blanford it was mistaken for *niger*. Wroughton called it *crossi*. I assign it to *bondar*, because of some resemblance it shows to the examples from Rohilkand described below. Hodgson, it may be added, appears to have seen a good many examples like his type of *hirsutus*, which he thought was the same animal as *bondar*, Desm., for he recorded the species, as quoted above, from the Nepal Tarai and the adjoining British territories to the north of the Ganges, including northern Bihar.

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I add *strictus* to the synonymy of *bondar* because Horsfield, who adopted Hodgson's M.S. name for the species, declared the type came from Nepal Tarai. This type (No. 79.11.21.546) in the British Museum is otherwise unidentifiable as *bondar* on account of the condition of the skin, which is in moult. No doubt Hodgson considered it to be specifically distinct from those he called *hirsutus* because he was unaware of the profound effect of coat change on colour and pattern. But admittedly it is extremely unlikely that two distinct forms occur in the Nepal Tarai. The skin exhibits a later stage of moult than that of the alleged type of *hirsutus*, as recorded above (p. 184).

According to Hodgson, as above quoted, *hirsutus* is found in British territory between the Ganges and the Nepal Tarai, as well as in the Tarai itself; and two handsome skins in full winter coat collected by Crump on March 8th, at Pilibhit, 800 ft., in Rohilkand, seem to belong to this race. Wroughton identified them as *crossi*. They apparently only differ from those seen by Hodgson in having the luxuriant woolly coat, which is 35 to 37 mm. long, white or silvery grey instead of clear yellow, with a pale slate-tint at the base. The difference in colour, similar to that which occurs in *hermaphroditus*, *pallasii* and other races, is possibly due to fading of the coat in March before the summer moult. The brow band also is white, the abdomen pale grey, the throat smoky grey. The dorsal surface is sprinkled with the black tips of the longer hairs, from 50 to 55 mm. in length, which at most show the faintest possible tawny tinge below the black. The pattern is vague, hardly to be described as consisting of definite black stripes and spots, but rather as irregular, elongated patches resulting from the confluence of the black tips of the longer hairs and therefore readily dissarranged. The basal half of the tail is, like the back, white, sprinkled with black. Of the two skins, one has no skull or measurements and cannot be sexed. The other is that of an oldish ♀. In the character of the pelage they resemble the examples of *scindiae* from Gwalior; but differ from them strikingly in general colour briefly describable as white with copious black speckling, the precise reverse of the colour of the winter coat of the 'silver-tip' fox, which is black with white speckling.[1]

Two additional skins, collected by Baptista in Darbhanga, 150 ft., support in a measure Hodgson's claim, likely enough to be true, that *hirsutus* occurs in N. Bihar, south of the eastern end of the Nepal Tarai. But both skins, owing to the time of the year, are in bad coat, differing in tint and in length and luxuriance from the March skins from Rohilkand. One (September 6), a young adult ♂ by the skull, has the wool shabby, thin and short, about

[1] An adult ♂ skin and skull in Hodgson's collection, referred to below under *pallasii*, may belong to this race. The skin hardly differs from the Rohilkand skins in coat and colour; but the skull agrees better with that of *pallasii*.

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20 mm. long; and dull grey in colour with here and there a tinge of tawny buff; there is a good deal of grey about the head. A few long hairs, 30 mm., are present on the hind-back, but there are more on the fore-quarters. The pattern is represented on the short coat of the back by three irregular stripes. The tail is in better condition, clothed in its basal half with clear grey wool, 30 mm., and sprinkled with the black tips of the longer hairs, 40 mm., thus closely resembling the tail of the Rohilkand skins. The second skin, an adult but not old ♀ (July 28), is generally similar to the last in coat and colour; the grey wool of the back is about 23 mm. and the long hair about 47 mm., but the dark tips of the hairs and the pattern have a decided brownish tinge as if faded. The large size of the teats and the naked area round them show that this specimen was suckling young. This skin, in general appearance and the state of the coat, closely resembles a skin of typical *hermaphroditus* collected on July 25 (? 27) by Baptista in the Palkonda Hills; but the long hairs are not so coarse and the wool is softer and silkier to the touch. A kitten from Darbhanga (*C. M. Inglis*) September 28, has abundance of greyish buff wool, with the longer black tipped hairs rather sparse and the pattern obscure.

The following table gives the available flesh measurements:—

Locality, Date and Sex.		In English Inches. Head and Body.	Tail.	Hind Foot.	Weight.	In Millimetres. Wool.	Hair.
'Nepal Tarai' (Hodgson)	♂	23	22	...	6 lbs.	35	58
Rohilkand; Mar. 8;	old ♀	20	18	3—	4 ,,	35	50
,, Mar. 8;	? sex.	...	...	...	...	37	55
Darbhanga; July 28;	yg. ad. ♀	18	19	3⅛	...	23	47
,, Sept. 6;	yg. ad. ♂	20	18	3½	8 lbs.	20	30

The length of the wool in Hodgson's specimen has been roughly estimated from his statement that it exceeds half the length of the long hairs. It seems probable that that specimen, like those from Rohilkand, was in full winter coat. The difference in coat length between the two examples from Darbhanga is probably to be explained by the retention of the long hairs of the winter coat in the July specimen.

To the following table of skull measurements of the examples from Rohilkand and Darbhanga are added those of three skulls,

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without skins and unsexed, belonging to Hodgson's collection; but they may belong to the following race *pallasii*.

Locality and Sex.	In English Inches. Total length	Zygom. width	Waist width	Int. orb. width	Max. width	In Millimetres. Bulla	Pm^4	M^1
Darbhanga; yg. ad. ♂	4·3	2·3	·5–	·7	·8–	16½	7½ × 5	5½ × 7
Nepal (Hodgson) yg. ad. ? sex	4·3	2·2	·4½	·8	·7	15	7½ × 5	5 × 7
Do. yg. ad. ? sex	4·2	2·2	·4	·7	·7–	16	8 × 6	6 × 7
Do. yg. ad. ? sex	4·1	2·0	·5	·6	·7–	...	7 × 6	5 × 7
Rohilkand; old ♀	4·1	2·2	·5–	·7	·6	15	7½ × 5	6 × 7½
Darbhanga; yg. ad. ♀	3·8½	2·0	·5½	·6½	·6¾	14	8 × 5	6 × 8

The skull from Rohilkand is entered as old because the teeth are much worn, perhaps not a convincing reason. It is about as large as the smallest ♀ skulls of *scindiae* and *hermaphroditus*; but the cranial material of this race is too inadequate for discussion.

PARADOXURUS HERMAPHRODITUS PALLASII, Gray.

Viverra prehensilis, Desmarest, *Mamm.*, p. 208, 1820 (not of Kerr, 1792).

Paradoxurus albifrons Ogilby, 1831 (unpublished at the time and preoccupied).

Paradoxurus pallasii, Gray, *Proc. Zool. Soc.* 1832, p. 67; *id. Illustr. Ind. Zool.*, pl. viii, 1834 and subsequent papers.

Paradoxurus quadriscriptus, Horsfield, *Ann. Mag. Nat. Hist.* (2), xvi, p. 106, 1885; *id. Proc. Zool. Soc.* 1856, p. 396, pl. 48.

Paradoxurus vicinus, Schwarz, *Ann. Mag. Nat. Hist.* (8), vi, p. 230, 1910.

Paradoxurus strictus, Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xxv, p. 48, 1917 (not *P. strictus*, Horsfield).

Locality of type of *prehensilis*: Bengal (Buchanan).

Locality of type of *pallasii*: India (Buchanan, probably therefore Bengal).

Locality of type of *quadriscriptus*: Nepal, in the hills.

Locality of type of *vicinus*: Probably Assam (McClelland).

Distribution: Nepal, Sikhim, Upper Bengal, Assam and Upper Burma.

Notes on the synonymy: The name *prehensilis*, referred to above under *bondar*, was based upon an alleged copy by Blainville

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of a painting by Buchanan Hamilton of a Palm Civet from Bengal. The description leaves no doubt that the name, if available, should be adopted for the race under notice; but, as Blanford pointed out, Kerr in 1792 called the American Kinkajou *Viverra prehensilis*. About the name *pallasii* there has been much difference of opinion. It was given to a living specimen in the Zoological Gardens brought by Buchanan (afterwards Buchanan Hamilton) from India, no doubt Bengal, where Buchanan was resident. A coloured drawing of it, also taken from the living animal, was published by Gray, and this seems to have misled Temminck into thinking that the animal was the same as the previously described Javan form he named *musanga*, an opinion which in 1864 was tentatively adopted by Gray himself in defiance of the history of the specimen he himself recorded. By Blanford *pallasii* was cited as a synonym of *hermaphroditus* on account presumably of the distinctness of the pattern depicted in the plate; and according to his application of the name *hermaphroditus* this verdict was correct. Wroughton considered *pallasii* to be synonym of the species he called *crossi* because the pattern is obscured by the bad make-up of the skin of the type preserved in the British Museum.

The plate in question is most misleading. It agrees neither with Gray's description nor with the specimen. The body colour is represented as slate grey and the brow band is unusually large and conspicuously white. In the type the ground colour is pale, faintly buffy whitish grey, noticeably paler than the brow-band which is buffy grey, not so extensive as in the plate and with considerably more deep brown round and between the eyes. The pattern, although disarranged, as stated above, by the 'make-up' of the skin consists of black dorsal stripes and lateral spots. The coat was apparently new at the time of the animal's death, but although not so thick with underwool or so long as in the winter coated specimens recorded below, is of similar soft texture and differs in this respect from the coat of the Burmese race assigned to *ravus*. The colour is clearer grey than in the palest of the specimens above referred to, but the difference is not nearly so great as between the palest and richest tinted examples of the series.

Horsfield's type of *quadriscriptus* which, on Hodgson's authority, came from the hills of Nepal, I cannot distinguish from several specimens collected for the Survey in Sikhim, Bhutan Duars, Upper Bengal and Assam. The type of *nigrifrons*, Gray, a menagerie specimen from India, closely resembles the type of *pallasii*, and has the pattern similarly obscured by the 'make-up' of the skin but is decidedly more buffy grey in ground tint. The type of *vicinus*, one of McClelland's specimens and probably from Assam, is indistinguishable from examples from Bhutan Duars. Wroughton correctly identified this race but called it *strictus* because of the distinctness of the pattern, due in reality to the moult, in the type of the latter.

Description: Winter coat full, soft, with abundance of underwool but shorter than in *bondar*, *laneus* and *scindiae;* general colour of the under hair varying from clear grey through shades of buffy

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grey to rich ochreous and only slightly dimmed by the black tips of the longer hairs; pattern well defined and at its best composed of spots on the flanks, thighs and shoulders and of five dorsal stripes, the right and left externals broken into spots, the median often not passing as far forwards as the shoulders; head with a pale patch on each side of the muzzle and below the eye, the brow-band varying in greyness, typically more or less interrupted by black speckling in the middle line and above the anterior angle of the eye; throat black; belly varying from grey to rich buff in the same locality; tail black at the end, generally obscurely striped in its proximal portion where the pale areas of the hairs and of the wool are exposed.

In addition to the types of *pallasii* and *nigrifrons*, already referred to, the British Museum has the following specimens:—

An old ♂ from Nepal, belonging to Hodgson's collection, but received without a name, I am very doubtful about. It is nearly intermediate between the pale examples of *bondar* from Rohilkand and the type of *quadriscriptus*. The ground colour is decidedly whitish, but the pattern is distinct although superficial and resulting from the confluence of the black tips of the long hairs (see note on the skull).

The type of *quadriscriptus* from the hills of Nepal has the coat in good condition, full and with the long hairs about 40 mm., their black tips surpassing by about 10 mm. the underlying pale portions which are buffy grey in tint; the pattern consists of very distinct stripes extending from the shoulders to the rump. Allowing for a certain amount of fading this skin agrees tolerably closely with Horsfield's description and with his coloured figure; but the fur, although soft, is not long and straggling, as he said.

An old ♂ from Narbong, Darjiling, 2,000 ft. (*Crump*), March 13, closely matches the type of *quadriscriptus* in coat, colour and pattern.

An adult pair from Sivok in Upper Bengal, S. of Darjiling, (*Crump*), March 26. Except for its rather longer coat the ♀ almost exactly matches the specimen from Narbong. The ♂ has the coat as in the latter but the colour is decidedly more buffy.

An adult ♂ from Hasimara, Bhutan Duars, 600 ft. (*C. Crump*), December 29, is pale buff like the ♂ from Sivok. Another adult ♂, January 6, is richer buff than any of the preceding, almost orange-ochreous buff in tint. There are also several immature specimens from this locality resembling the adults and similarly varying from greyish buff to almost orange-ochreous buff; the bellies similarly vary from grey to buff.

A young ♂ from Haldibari in Cooch Behar. 150 ft. (*C. Crump*), April 17, is in poor coat, apparently beginning to change; the hind-back, rump and root of tail are decidedly buffy, but the bright hue dies away forwards.

A flat, unmeasured ♂ skin from the Duranga River, North Kamrup (*Wells*), February 10, is hardly distinguishable from the specimen from Narbong, Darjiling.

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A flat, unsexable skin from Dura Banda, Garo Hills (*Wells*), March 12, is tawny buffish grey in tint, intermediate between the paler and better coloured varieties.

An old ♂ and a young adult ♂, both unmeasured, from Golaghat in Sibsagar, north of the Naga Hills, Assam (*Wells*), January 10 and 26, are rich ochreous buff in colour with the pattern well defined, like the richest tinted of the skins from Bhutan Duars. The coat measurements are 28 and 32 mm., and 32 and 40 mm. respectively.

An adult mounted specimen from Cachar, Assam (*Rowland Ward*), has the ground colour pale buffy white, the pattern well defined, the brow-band reduced to two grey patches on each side and the grey muzzle-patch suppressed; the coat is 24 and 36 mm.

Two young adult ♀ examples (*McClelland*), probably from Assam. One, the type of *vicinus*, resembles in the coat, which is 27 and 37 mm., and in colour, the brighest tinted skins from Bhutan Duars and Golaghat. The other, with similar coat, is considerably greyer, like the less brightly tinted of the previously described skins.

A young specimen from the Uvu Forest, 60 miles East of Homalin in Upper Chindwin, and indistinguishable in coat and colour from the richly tinted Assamese examples, attests the extension of *pallasii* into N.-W. Burma.

The following are the specimens in which flesh measurements are available:—

	In English Inches.				In Millimetres.	
Locality, Date and Sex.	Head and body	Tail	Hind Foot	Weight	Wool	Hair
Hasimara, Bhutan Duars; Dec. 29; ad. ♂	24⅜	23	3⅜	...	29	37
Hasimara, Bhutan Duars; Jan. 6; ad. ♂	23⅛	22⅛	3½	...	26	34
Sivok, Upper Bengal; Mar. 26; ad. ♂	22	21⅓	3⅜	...	25	38
Haldibari, Cooch Behar; Apr. 17; yg. ♂	20	21⅛	3½	5¾ lbs.	22	36
Duranga River, N. Kamrup; Feb. 10; ♂	22	...	3⅛	5 ,,	27	38
Sivok, Upper Bengal; Mar. 26; ad. ♀	22⅜	22⅛	3½	...	34	43

This table shows inferiority in size of *pallasii* as compared with *laneus* and *scindiae* and superiority over *hermaphroditus*. The

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winter coat also is shorter both in wool and long hair than in *bondar*, *laneus* and *scindiae*, and the long hairs are shorter than in *nicti-tans* and *hermaphroditus*.

Cranial and dental measurements:—

	In English Inches.					In Millimetres.		
Locality and Sex	Total length	Zygom. width	Waist width	Int. orb. width	Max. width	Bulla	Pm^4	M^1
Nepal (Hodgson) old ♂ ...	4·7½	2·5	·4	·8¼	·8	22	9 × 5½	6 × 8
Nepal (Hodgson) yg. ad. ♂ ...	4·5	2·3½	·5	·8	·8	18	7? × 6	5 × 7
Narbong, Darjiling; old ♂ ...	4·5	2·5½	·4	·7½	·8	18	9 × 6	6½ × 7
Hasimara, Bhutan Duars; ad. ♂ ...	4·7	2·5	·4	·8	·8	19	8 × 6	6 × 7
Hasimara, Bhutan Duars; ad. ♂ ...	4·6	2·6	·5	·8	·8¼	18	8 × 6	6 × 8
Sivok, Upper Bengal; ad. ♂ ...	4·4	2·5	·4	·7	·7	19	9 × 6	6 × 7
Haldibari, Cooch Behar; yg. ♂ ...	4·2	2·3	·5	·7–	·7	16	8½ × 6	7– × 8
Golaghat, N. E. Assam; old ♂ ...	4·6	2·8½	·5	·8½	·8	17	...	...
Golaghat, N. E. Assam; yg. ad. ♂	4·1⅛	...	·5	·6½+	·7	15⅛	9 × 7–	6 × 8–
Sivok, Upper Bengal; ad. ♀ ...	4·2	2·2	·5	·6½	·7	17	8 × 6	6 × 8
?Assam (*vicinus*. type) yg. ad. ♀...	4·1⅛	2·2	·5	·7	·7–	17	8¼ × 6	6 × 7½

The first skull on this list belongs to the skin in Hodgson's collection, above referred to, which in pattern and colour is more like whitish examples of *bondar*. Apart from the bullae which are exceptionally long, it agrees tolerably closely with the biggest of the rest. The second skull, also Hodgson's, has no skin and like the first is doubtfully inserted here. The teeth are short, but it is peculiar in the extreme abbreviation of the obtusely angular postorbital processes which are only 22 mm. from point to point, clearly an abnormality.

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In the rest the skulls and teeth closely resemble in size those of *hermaphroditus* and *laneus*. The skull of the old ♂ from Golaghat with a condylobasal length of 115 mm. has the sagittal crest 4½ mm. high and the postorbital processes 36 mm. from point to point, large and transversely directed as in the type of *laneus* and in the old skull of typical *hermaphroditus* from Bellary. The ♂ skull from Narbong, Darjiling, with a condylobasal length of 113 mm. is similar, with the sagital crest 5 mm. high but the postorbital processes only 30 mm. from point to point. The larger ♂ skull from Hasimara, with a condylobasal length of 118 mm. and the occipital suture just traceable also has the sagittal crest 5 mm. high, but the processes are defective. In the rather older ♂ skull from Sivok, with a condylobasal length of 111 mm., the crest is only 3 mm. high and the processes are thinner than in the Narbong skull and 31 mm. from point to point.

The skull of the adult ♀ from Sivok, with a condylobasal length of 109 mm., and the occipital suture obliterated, has no true sagittal crest, the temporal ridges being merely coalescent to form a median ridge with slightly undulating edges, 3 mm. wide, on the parietals. In the young adult type-skull of *vicinus*, with the basi-occipital suture unclosed but the dentition complete and the median frontal suture obliterated, the temporal ridges are 2½ mm. apart on the frontals, 8 mm. on the parietals. In the young adult ♂ skull from Golaghat, shown to be younger by the unfused median frontal suture, but with complete dentition, the temporal ridges are 6 mm. apart on the frontals, 10 mm. on the parietals. This comparatively late development of the sagittal crest in ♀ *pallasii* may be contrasted with its average earlier development in the following race *ravus*.

(*To be continued*).

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FURTHER RECORDS OF INDO-CEYLONESE CHALCID FLIES.

BY

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and

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Over fifteen years ago the senior author published an annotated list[1] of the then known chalcid flies of the Indo-Ceylonese region and two years later he issued another paper[2] on the parasitic hymenoptera of South India in which were included some more of the chalcid flies which were not recorded previously. Since then many more forms have been noted and it is the object of this paper to supplement the earlier lists with a record of the Indo-Ceylonese forms which have been noted and identified recently with brief notes as regards their hosts, locality, distribution etc., and with bibliographical references. As a continuation of the previous lists it is hoped that this paper may serve to bring our knowledge of the Indo-Ceylonese forms uptodate and in view of the economic importance of these minute wasps as natural enemies of some of our important crop-pests it may be of some help to agricultural entomologists who may be interested in the biological control of insect pests by means of various insect parasites. The thanks of the writers are due to Dr. Ferriere of the Imperial Institute of Entomology, London, to Prof. Timberlake, the famous Californian authority on Chalcids and to others who examined our specimens and helped us in getting them identified for us. It is also hoped that this list might prove of some use as a reference list to those interested in the study of this interesting group of parasites.

SUPERFAMILY: CHALCIDOIDEA.

FAMILY: AGAONIDAE.

Blastophaga Grav.

Sub-genus: *Elizabethiella* Grandi.

Blastophaga (*Elizabethiella*) *gomberti*, Grandi, Bull. Soc. Zool. Fr. liii, p. 70 (1928), India.

Ceratosolen Mayr.

Ceratosolen berlandi, Grandi, Bull. Soc. Zool. Fr. liii, p. 74 (1928), India.

FAMILY: CHALCIDIDAE.

Leucospis Fabricius.

Leucospis malabarensis, Brues, Psyche, xxxii, p. 27 (1925), India.

Euchalcidia Masi.

Euchalcidia crassicornis, Masi, Bull. Ent. Bologna ii, p. 173 (1929), India.

Dirhinus Dalman.

Dirhinus pachymerum, Masi, Eos. iii, p. 42, India.

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[1] 'A Check List of Indo-Ceylonese Chalcid Flies' by T. V. Ramakrishna Ayyar, *Spolia Zeylanica*, vol. xiii, 1925.

[2] 'The Parasitic Hymenoptera of Economic Importance in South India' by T. V. Ramakrishna Ayyar, *Bulletin of Entomological Research*, vol. xviii, 1927.

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Brachymeria Westw.

Brachymeria nephantidis, Gahan, Proc. U.S. Nat. Mus. No. 2831, Art. 77, p. 5 (1930), on Nephantis, India.

Hockeria Walk.

Hockeria atra, Masi, Boll. Lab. Ent. Bologna, ii, p. 180 (1929), India.

Stenochalcis Masi.

Stenochalcis quadridentata, Masi, Boll. Lab. Ent. Bologna, ii, p. 157 (1929), India.

FAMILY: EUCHARIDAE.

Schizaspidia Westw.

Schizaspidia manipurensis, Clausen, Proc. Ent. Soc. Wash., xxx, pp. 83, 85 (1928). Manipur State, Assam, India.

FAMILY: TORYMIDAE.

Podagrion Spinola.

Podagrion pachymerum, Walk. Ramaswamiah, Madras Agril. Dept. Year Book, pp. 55-57 (1922). An account is given about the oviposition.

FAMILY: ENCYRTIDAE.

Erencyrtus Mahdihassan.

Erencyrtus dewitzii, Mahdihassan, Jl. Sc. Assoc. Maharajah's College, Vijianagaram, i, p. 71 (1923). On lac. Mysore, India.

Lissencyrtus Cameron.

Lissencyrtus somervillc, Mahdihassan, Jl. Sc. Assoc. Maharajah's College, Vijianagaram, i, p. 71 (1923). On lac. Mysore, India.

Tachardiaephagus Ashmead.

Tachardiaephagus tachardiae (How.) Ferriere, Bull. Ent. Res. xix, Pt. 2, p. 171 (October 1928). Synonymical notes given:
= *Encyrtus tachardiae*, Howard, 1896.
= *Tachardiaephagus thoracicus*, Ashmead, 1904.
= *Lissencyrtus troupi*, Cameron, 1913.
According to Dr. Ferriere the species *somervillc* should be included in this genus and the same can be distinguished from *T. tachardiae* (How.) 'especially by the colour of the head, which is orange yellow like the thorax, instead of dark'. Insects noted on lac, on *Zizyphus jujuba;* Bengal, India.

Encyrtus Latreille.

Encyrtus barbatus, Timb., on *Lecanium nigrum*, Coimbatore, India.

Microterys Thoms.

Microterys kotinskyi, Full. on *Lecanium nigrum*, Coimbatore, India.

Tetracnemus Westw.

Tetracnemus indicus, Ramakrishna, Rec. Ind. Mus. xxxiv, Pt. iii, pp. 287-288 (September 1932). Parasites of an injurious mealy bug *Pseudococcus citri* commonly noted on Agathi—*Sesbania aculeata* in Coimbatore, India.

Homalotylus Mayr.

Homalotylus flaminus (Dalm.). On *Coccinellid*, Coimbatore, India.

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FAMILY: PTEROMALIDAE.

Trigonogastra Ashmead.

Trigonogastra brunneicornis, Ferriere, Bull. Ent. Res. xxi, Pt. 3, pp. 356-357 (October 1930). Species described. On Pupa of *Agromyza* sp. mining stems of *Hibiscus esculentus*. This species differs from *T. rugosa* and *T. megacephala* 'by the large size, the darker green coloration of head and thorax, the presence of four teeth on both mandibles and the more elongated funicle joints.' Peradeniya, Ceylon.

Acroclisoides Girault.

Acroclisoides indicus, Ferriere, Bull. Ent. Res. xxii, Pt. 2, pp. 279-280 (June 1931). Species described. 'Genus is well characterized by its large head, which is much broader than the thorax and broader than long when seen in front, by the elongate antennae with two ring-joints, the thickened marginal vein, the very short petiole, and the small triangular abdomen.' Also key to species of the genus given. On eggs of a Pentatomid bug on teak leaf. Dehra Dun, U.P., India.

Agiommatus Crawford.

Agiommatus acherontiae, Ferriere, Bull. Ent. Res. xxii, Pt. 2, pp. 280-281 (June 1931). Species described. Key for distinguishing the three species of the genus given. On eggs of *Acherontia styx*, Westw. Dehra Dun, U.P.

FAMILY: PERILAMPIDAE.

Perilampus Latr.

Perilampus microgastris, Ferriere, Bull. Ent. Res. xxi, Pt. 3, pp. 353-354 (October 1930). Species described. A hyper-parasite on *Microgaster indicus*, Wilkn., *Apanteles machaeralis*, Wilkn., and a Braconid parasite of *Nephantis serinopa*, Meyr., Hosangabad, C.P., and Dehra Dun, U.P., India.

FAMILY: ELASMIDAE.

Elasmus Westw.

Elasmus brevicornis, Gahan, Treubia iii, p. 50 (1922): Type locality Java, Buitenzorg: Host—*Erionata thrax*, L.; Ferriere, Bull. Ent. Res. xx, Pt. 4, p. 413 (December 1929). Parasitic on larva of *Hapalia machaeralis*, Wlk., on *Tectona grandis*, Dehra Dun, India, also noted in Kuala Lumpur, Malaya, from *Psalis stultalis* on *Pogostemom patchouli*, and also found parasitic on larva of *Sylepta derogata*.

Elasmus ceylonicus, Ferriere, Bull. Ent. Res. xx, Pt. 4, p. 418 (December 1929). Species described. From cases of *Psyche albipes*—the Tea Bagworm, Pelmadulla, Ceylon.

Elasmus homonae, Ferriere, Bull. Ent. Res. xx, Pt. 4, pp. 415-416 (December 1929). Species described. From *Homona coffearia*, Nietn., on tea, Ceylon. Points that distinguish this species from *E. nephantidis*, Roh., are also given.

Elasmus hutsoni, Ferriere, Bull. Ent. Res. xx, Pt. 4, p. 412 (December 1929). Species described. Bred from cases of the Tea Bagworm *Psyche albipes*, Mo., Pelmadulla, Ceylon.

Elasmus hyblaea, Ferriere, Bull. Ent. Res. xx, Pt. 4, p. 414 (December 1929). Species described. Parasitic on second instar of *Hyblaea puera* larva, Aravallica, Nilambur, Madras.

Elasmus johnstoni, Ferriere, Bull. Ent. Res. xx, Pt. 3, pp. 258-259 (October 1929). Species described. Karnal, Punjab, India. Bred from *Platyedra gossypiella* and *Earias spp.*

'This species may be distinguished by the dark colouration of its body and legs, by the hind tibiae being clear with a brown ring below the middle and by the form of antennae and abdomen.'

Elasmus claripennis, Cameron. Ferriere, Bull. Ent. Res. xx, Pt. 4, p. 418 (December 1929). Synonyms given:

= *Cyclopleura claripennis*, Cameron, Ind. For. Rec. iv, p. 92 (1913).

= *Elasmus colemani*, Mahdihassan, Jl. Sc. Assoc. Maharajah's College, Vijianagaram, i, p. 69 (1923) as parasitic on *Eublemma amabilis*, M.; bred

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with *Tachardia lacca* from *Eublemma amabilis* predaceous on the former, India, Dehra Dun and from Bengal; Ferriere, Bull. Ent. Res. xix, Pt. 2, pp. 171-172 (October 1928). Species described. The relationship of the genus *Cyclopleura* with *Elasmus* given and the synonyms discussed. The distinguishing features that characterise *E. claripennis*, *E. indicus*, Roh., and *E. nephantidis* Roh., are also given.

FAMILY: EULOPHIDAE

Pleurotropis Forster.

Pleurotropis detrimentosus, Gahan, Proc. U.S. Nat. Mus. No. 2831, Art. 77, p. 9 (1930). India.

Thripoctenus Craw.

Thripoctenus maculatus, Waterston, Ann. Mag. Nat. Hist. v (10), pp. 213-214 (1930). Species described. Punjab, India. An internal parasite of the Vine thrips (*Rhipiphorothrips cruentatus*, H.).

Coccophagus Westw.

Coccophagus tschirchii, Mahdihassan, Jl. Sc. Assoc. Maharajah's College, Vijianagaram, i, p. 82 (1923). Reared from the Mysore lac insect; Ferriere, Bull. Ent. Res. xix, Pt. 2, pp. 173-174 (October 1928). Fully described; Compare, Proc. U.S. Nat. Mus. vol. lxxviii, Art. 7, p. 41 (1931). Redescribed from specimens from Bengal, Kundari, 1927, on Lac insect on *Butea frondosa*.

Tetrastichus Haliday.

Tetrastichus gardeneri, Ferriere, Bull. Ent. Res. xxii, Pt. 2, pp. 291-292 (June 1931). Species described: from eggs of Pentatomidae on teak; from the same eggs were also bred *Acroclisoides indicus*, and an *Eupelmid* identified as *Anastatus colemani*, Craw.; notes on Tetrastichus species given as regards their parasitic habits, Dehra Dun, India.

Tetrastichus schoenobii, Ferriere, Bull. Ent. Res. xxii, Pt. 2, pp. 290-291 (June 1931). Described: Malaya Peninsula, Ceylon and Siam on eggs of *Schoenobius bipunctifer* (Malaya and Siam) and of *Spodoptera mauritia* in Ceylon; also noted on eggs of Schoenobius in South India.

Sub-genus: *Geniocerus* Ratz.

Tetrastichus (*Geniocerus*) *purpureus* (Cam.). Ferriere, Bull. Ent. Res. xix, Pt. 2, pp. 174-175 (October 1928). Synonyms given: Reared from Lac on *Zizyphus jujuba*, Bengal. Its relationship with the synonyms given and also the distinguishing features of the sub-genus *Geniocerus*, Ratz.

Trichospilus Ferriere.

Trichospilus pupivora, Ferriere, Bull. Ent. Res. xxi, Pt. 3, pp. 358-359 (October 1930). Species described. On *Nephantis serinopa*, Meyr. Coimbatore, India; Peradeniya, Ceylon etc.

Note.—'By an oversight the record of the species *Trichogramma minutum*, R. (TRICHOGRAMMATIDAE) was left out in the text. It has been noted in India on the eggs of the sugarcane borers (*Diatraea*, *Argyria* and *Scirpophaga* spp.), the paddy stem borer (*Schoenobius incertellus*, W.) and the stored paddy moth (*Sitotroga cerealella*, Ol.). During recent years this wasp assumed very great importance as an important parasite and a good deal of literature has accumulated in connection with its utility as a natural enemy of borers on cane.'—(T.V.R. & V.M.)

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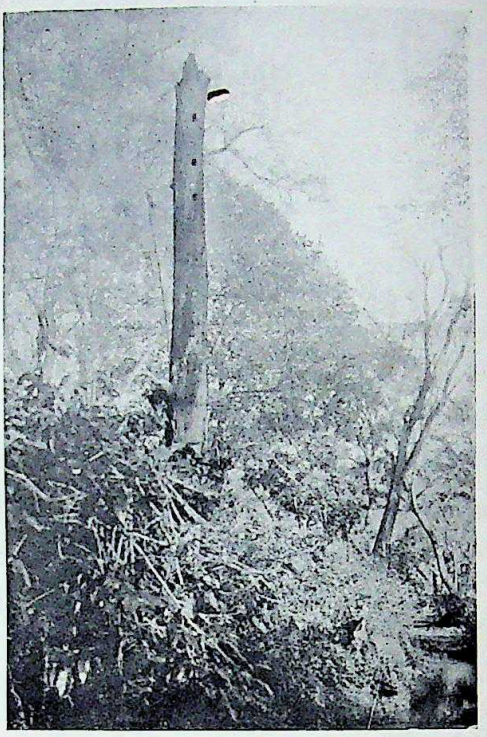
1. Southern Golden-backed Woodpecker at nest.[1]



2. Nest holes of Malherbe's Golden-backed Woodpecker.

3. Young Southern Golden-backed Woodpecker.

[1] This nest entrance was originally quite round but has been enlarged with a knife to secure the eggs.

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SOUTH INDIAN WOODPECKERS.

BY

F. N. BETTS.

The heavily wooded slopes of the Nilgiris and other ranges of the Western Ghats provide an ideal habitat for the Woodpeckers, a family which is richly represented in Southern India. Even the most casual observer cannot help being struck by their abundance and variety, for their brilliant plumage and loud voices make them among the most conspicuous of the avifauna of the hill jungles.

The woodpeckers furnish an interesting study in evolution and an excellent example of how under favourable conditions, a particular form of life will tend to develop on widely divergent lines. The most striking instance of this phenomenon is the unique fauna of Australia, where the primitive marsupial mammals which have been ousted by more efficient rivals throughout the rest of the world, have, through the isolating action of a sea barrier, been freed from competition and enabled to evolve types as different as the kangaroos and the marsupial wolf, the Tasmanian devil and the pouched mole. In a similar way on a small scale, the Woodpeckers, having tapped a source of food supply unavailable to other birds, have thrown up a great variety of species all more or less highly specialised for their line of life. In their case, however, the process is in a much earlier stage and there are living genera showing every grade from comparative primitiveness up to a very high degree of specialisation. So far progress has been all on one particular line but it seems as if the limit has been reached in that direction and that various species are now beginning to evolve along different paths.

The two greatest controlling factors in bird life are the food supply and the problem of safeguarding their young whilst they are in the helpless stage. The woodpeckers have solved both questions very successfully by developing themselves into living pick-axes. The ordinary insectivorous birds can only obtain their food on the leaves and outer surfaces of the boughs and trunks of trees and are quite unable to get at the rich stores of invertebrate life lurking under the bark or boring into the wood and the woodpeckers have a free field. Again in the matter of breeding sites, birds which nest in holes have many advantages and are far less exposed to the elements and their enemies than those which build open nests in trees or lay their eggs upon the ground. Many species of almost every order of the avian class have adopted the hole-breeding habit and probably more would have done so had it not been for the comparative scarcity of suitable natural hollows. One has only to think of the extraordinary sites often chosen by Tits to realise the straits to which some birds may be put. The Parrots, Nuthatches and others have got as far as enlarging or adapting ready-made holes but it is only the Woodpeckers and their cousins the Barbets who have solved the

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problem and made themselves independent of nature by learning to tunnel in wood. There are of course many other birds which excavate holes in the ground but that is another story. As a matter of fact, the majority of the smaller and medium sized birds which nest in holes in trees are parasitic on the Woodpeckers in so far as the disused 'dug-outs' of the latter are eagerly adopted as breeding sites and the rightful owner may even be evicted whilst still in occupation in certain cases.

Though the family by specialising have been so successful in exploiting their particular environment, it must be remembered that this is a strictly limited one. The typical Woodpecker can only exist in well wooded regions and even in such a considerable area is necessary to support each bird. Thus we find a keen and ever increasing competition among the various members of the family forcing some species to diverge from the main type to begin to seek a livelihood along different lines. As the pressure in the more congenial environment increases they are forced to adapt themselves to less agreeable conditions until we find them colonising areas so apparently unsuitable as the Arizona desert or the treeless Pampas of South America.

The region covered in this paper is a particularly suitable one for the study of the evolution of the Woodpeckers. For among the twelve species that occur are types representative of every phase in the history of the family. Before going further it would be as well to give some account of them.

1. **The Little Sealy-bellied Green Woodpecker,** *Picus vittatus myrmecophaneus* (Stresemann) appears to be an uncommon species. Davison says a few pairs are resident in the sholas round Ootacamund and the only two I have seen were on the borders of copses on the downs of the Nilgiri plateau. It seems to feed mainly on ground dwelling ants like its English congener *Picus viridis* and is consequently partial to park land and open country.

2. **The Southern Yellow-naped Woodpecker,** *Picus chlorolaphus chlorigaster* Jerdon is very widely spread throughout the forested regions of South India and wanders up to 5,000 ft. but is not common above about 3,500 ft. Rather a shy, solitary species it is only to be found in heavily wooded country being particularly fond of dark, marshy ravines clad in evergreen forest or the borders of jungle streams, where it hunts over rotting fallen trees. The nest is excavated usually quite low down in a rotten stump in heavy jungle. The entrance is a neat round hole seemingly very small for the bird and on two occasions I have found them made just below where a large flat fungus jutted out from the tree like a half plate and almost concealed the nest. After the breeding season small family parties are to be seen but they do not hang together for long. They are silent birds, their only note being an occasional loud sharp 'tchak'.

3. **The Southern Yellow-fronted Woodpecker,** *Leiopicus mahrattensis mahrattensis* (Lath.) is a low country species which seldom ventures far into the hills and only into the drier areas such as the northern slopes of the Nilgiris round Masinagudi where the jungle is of a light dry zone type mostly teak, scrub and bamboo.

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4. **The Southern Indian Pigmy Woodpecker,** *Yungipicus hardwickii hardwickii* (Jerdon) is widely spread and much commoner than one suspects as owing to its size and habits it is very inconspicuous. Entirely arboreal it keeps to the topmost branches of high trees where it is extremely active in running over the boughs and is constantly on the wing as it flits from one twig to another. Pairs and single birds are the rule though they very frequently go about in company with the large mixed flocks of insectivorous birds which are such a feature of the monsoon. They are more like Nuthatches in their ways than Woodpeckers though they cannot run head downwards as the former do. In their flight too, they lack the bounding action so characteristic of the family. Parklands and open woodlands are their favourite haunts and they will ascend as high as 4,500 ft. in suitable country though commoner at lower elevations. Like all our Woodpeckers they are very early breeders, having young by the end of February. The nest-hole is usually excavated very high up in a small dead bough of a tree standing more or less in the open. This is the only Woodpecker which I have seen with food in its bill when visiting the nest, the usual habit being to regurgitate from the crop. In this case, the male used to fly up with a beakful of insects uttering his little trilling call, on hearing which the female who was in the nest would poke her head out to receive the prey.

5. **The Southern Rufous Woodpecker,** *Micropternus brachyurus gularis* (Jerdon) is a rather scarce species but well distributed in forest country up to about 4,000 ft. They are silent and solitary birds. Their food seems to consist almost exclusively of ants both terrestrial and arboreal. Their breeding habits are remarkable for the breeding cavity is always excavated in a nest of the arboreal *Cremastogaster* ants, which build those black football-shaped papier-mâché-looking affairs so common in the jungle trees. I have never had the luck to find one but many observers state that the Woodpeckers choose occupied colonies and that the ants remain in possession throughout the period of incubation though doubtless they are mostly devoured by the birds before very long. Davison remarks that he has found small naked young of this species in a nest still swarming with ants which is extraordinary when one considers that these insects are among the greatest menaces to which the helpless nestlings of most birds are subject.

6. **The Southern Golden-backed Woodpecker,** *Brachypternus benghalensis puncticollis* (Malherbe) is quite the commonest Woodpecker below 4,000 ft., occurring numerously almost everywhere trees are to be found. Above that level its place is taken by Malherbe's Golden-backed Woodpecker (*q. v. infra*) which is definitely a hill species. In the Nilgiris it does not seem to wander much above the plains level but in Coorg at any rate it is extremely common at 3,500 ft. and there is a zone in which both species occur. On the whole *B. benghalensis* prefers the drier and lower regions and *Chrysocolaptes guttacristatus* the higher and wetter. The Golden-backed Woodpecker is a very noisy bird and decidedly sociable. The family parties hang together until the following breeding season and in the monsoon they are always to be found

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in the large mixed flocks which gather at that time of year. They are mainly arboreal in their habits but come to the ground on occasion. Their staple food is ants of various sorts but they will take any insects they find. On one or two occasions an odd fruit or two has been taken from the stomachs of specimens but this was probably accidentally swallowed. I have on two occasions seen one drinking honey, once from the blossoms of an *Acrocarpus* and once from a *Grevillea*. The bird looked most out of place clambering awkwardly among the sprays. They are mainly arboreal but come to the ground occasionally. Like all our Woodpeckers, this species is an early breeder and the two or three eggs are usually laid by the end of February. The nest-hole with its neat round entrance is excavated in dead trees at any height but most commonly from 10-20 ft. up. The sitting bird is very wary poking her head out at the first sound of approaching footsteps though she will often delay taking flight until one is quite near, thus betraying the presence of an otherwise unsuspected nest.

7. **The Golden-backed Three-toed Woodpecker,** *Dinopicus javanensis rubropygialis* (Malherbe) is another common species inhabiting much the same range as the last. Superficially the three Golden-backed Woodpeckers are extraordinarily similar. In the hand, of course, they can be distinguished without difficulty but in the field this is by no means the case. Size is little criterion unless one has a standard of comparison and the easiest points to look for are the colours of the hindneck, which is white in *C. guttacristatus* and black in the other two species, and the rump and lower back which in the case of *B. benghalensis* is black but crimson in the other two. In general habits the present species closely resembles the last but its call is quite distinct being a rather weak, tinny scream. The breeding season is in January and February and it seems to choose extremely rotten trees in which to excavate its nest. I have found one or two dug in such decayed wood that it was possible to enlarge the hole with no tools other than the fingers.

8. **Malherbe's Golden-backed Woodpecker,** *Chrysocolaptes guttacristatus delesserti* (Malherbe) as before mentioned is a hill species and the only Woodpecker at all common on the plateau and higher slopes of the Nilgiris. In Coorg it is found from the tops of the highest hills at 5,000 ft. and more, down to below 3,000 ft. It is more of a forest bird than *Brachypternus benghalensis* and while by no means shy or averse to the neighbourhood of mankind, it is very much at home in the interior of the heavy evergreen woods which clothe the hillsides in the wetter areas where it hunts among the great tree trunks, seldom coming near the ground. Except in the breeding season small family parties are the rule but they are select and do not mingle with other species. They are excessively noisy especially when alarmed their cry being a discordant trilling scream. The breeding season seems to be very early even for this family. I have found eggs by the middle of December. A favourite tree will be used year after year, a fresh hole being excavated each time until the trunk is so riddled with borings that it collapses. A distinctive characteristic of the species

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is that the entrance to the hole which is very large for the size of the bird is practically never neatly circular as in the case of most Woodpeckers, but is a rather irregular oval deeper than it is wide. In one case I found it took a full month to excavate the cavity.

9. **The Black-Backed Woodpecker,** *Chrysocolaptes festivus* (Bodd.) is rare in South India and there are but few records of its occurrence. Hume obtained specimens and Howard Campbell a nest at the northern foot of the Nilgiris.

10. **The Malabar Heart-spotted Woodpecker,** *Hemicircus canente cordatus* Jerdon though nowhere numerous is to be found over most of the wooded hilly country of South India, wandering as high as 4,500 ft. on the Nilgiris. They are most comic little birds having all the family mannerisms exaggerated to an absurd degree. Their flight is weak and excessively undulating. The tail is extremely short and this is very apparent when on the wing and gives them the appearance of having met with an accident. When running up a bough, they move in short, sharp jerks accompanied by convulsive bobs and bows so that they look more like clockwork toys than living creatures. They are solitary birds and great wanderers seldom remaining long in any one locality. They rather shun cultivated land but otherwise their tastes are catholic and they may be found anywhere there is a good growth of timber. They are entirely arboreal and hunt very largely among the thin terminal twigs where they as often perch across a branch, albeit somewhat awkwardly, as in the normal Picine manner. The call is a very characteristic and rather pleasant 'twee, twee, twee' which is sometimes extended into a trill of seven or eight notes. There seems to be little known of the breeding habits of this bird. I have not so far been fortunate enough to find a nest but both in the Nilgiris and in Coorg the birds are paired in January and February and it is probable that they breed then in common with most of the members of the family.

11. **The Malabar Great Black Woodpecker,** *Thiroponax javanensis hodgsonii* (Jerdon) is typically a bird of the heaviest evergreen forests of the Western Ghats where it occurs fairly commonly up to 4,000 ft. In Coorg I have seen it in the drier and more open teak and bamboo jungle of the Mysore border but it is only a wanderer there. Shy and wary, they keep to the interior of the forests and only occasionally venture into cultivation on the jungle edge. Such large birds need a wide range so that the numbers in any one locality are never great. They seem to work a considerable area with some regularity for a family of three or four used to appear in the neighbourhood of my bungalow in the Nilgiris for a few days every six weeks or so for months on end. They would be seen for a couple of days and then disappear until their next visit fell due. Except in the breeding season small parties keep together. They are very noisy and the single, wild clanging note is audible at a great distance. As they take wing this call is often expanded into a ringing laugh. They seem to be exclusively arboreal and frequent the largest and tallest trees, hunting over the trunks and main boughs seldom venturing out among the smaller branches.

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12. **The Nilgiri Piculet,** *Picumnus innominatus avunculorum* Hartert is a rare species only reported from Travancore, Wynaad and the Nilgiris. I have only seen it on two occasions, both on the Nilgiri slopes at about 4,500 feet among scrubby trees on the border of open grassland. In habits they were more like Nuthatches than Woodpeckers being very active in running up and down among the thin outer branches, frequently perching across them and taking wing to pass from one to another. They were silent little birds very much preoccupied in their affairs and very tame or rather quite indifferent to the presence of man. Their flight was strong and direct with but little of the usual Woodpecker bounds.

It seems probable that the original Woodpecker stock came from small birds with normal tails and comparatively small though powerful bills which obtained their food much as the Nuthatch does by searching the branches of trees for the small insects concealed in the bark and which bred in natural holes, but gradually learned to enlarge and adapt them for their purposes. The Piculets even at the present time, have hardly advanced beyond this stage as their tail feathers are still soft and weak and the bill fairly short and conical. While they do on occasion excavate a complete hole, they nearly always breed in bamboos which only entails making an entrance into the ready-made hollow interior. Once started on this line of advance, specialisation proceeded apace; the tail feathers stiffened to act as a support and a fulcrum, the bill became flattened and lengthened until it formed a most efficient chisel while the tongue grew long and sticky to aid in the withdrawal of grubs from their galleries in the tree trunks. Size also increased until the typical Woodpeckers reached their acme in species such as the Great Black Woodpecker and the Slaty Woodpecker of Burma and Assam. It would seem that the latter represent about the size limit for birds of their particular habits, as these giants of the race are seldom numerous, and require a very large territory to provide them with a sufficiency of food, besides being necessarily restricted to the densest and biggest forest country.

With increasing size the typical Woodpeckers become more and more dependent on wood-boring grubs as food though ants are always a great stand-by with all the members of the family. The larger species are prevented by their size from working the smaller leafy branches and outermost twigs, the regions richest in insect-life, while ants and such small fry unless available in great quantity do not make nearly so satisfying a meal as a few large juicy grubs. Accordingly, it is in the largest forms that the greatest development of the bill is found. In the smallest birds, like *Yungipicus hardwickii* and *Hemicircus canente*, the bill is sharply pointed and fairly short. In the medium genera such as *Leiopicus* and *Dinopicus* it is still pointed but comparatively much longer and stronger. In the largest of all such as *Thriponax* and *Chrysocolaptes* it terminates in a flat chisel edge, a much more efficient tool than a mere point.

While the majority of our Woodpeckers conform to type in

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their habits there are at least two genera which show a well-marked divergence from the main path. The Green Woodpeckers, for instance, as typified by *Picus vittatus* are apparently gradually turning into ground feeders. Whilst still true Woodpeckers in all respects they obtain a great deal of their food by preying on terrestrial ants' nests and have left the heavier forests for lighter and more open woodlands, venturing right out into treeless country in search of their favourite rations. In our local species this trait is only in its early stages but it is carried much further in other countries such as the Argentine where trees are scarce.

The Rufous Woodpecker has followed a different line of development to the extent of becoming almost a parasite on the arboreal *Cremastogaster* ants. It is not a very common species but as far as my personal observation goes, it lives almost entirely on these ants, seldom, if ever boring for grubs though it occasionally comes to the ground and has been seen by Legge breaking up dried cowdung in search of the maggots and beetles below. The sticky acrid substance which is nearly always found smeared over the head and breast of birds of this species is said to be derived from the ants' nests into which it burrows, but there seems a possibility that it might be a secretion of the bird itself, developed as a defence against the enraged insects whose homes it attacks and uses for breeding purposes.

Before closing this paper I must allude to the curious habit of drumming indulged in by many if not all Woodpeckers. There has been a lot of discussion lately in the *Field* and other papers as to whether this sound is produced purely mechanically or whether it may be vocal. I have watched birds in the act at close quarters on several occasions and as far as I could detect the former is the correct view. A particular and presumably specially resonant dead branch is chosen and the bird proceeds to tap it with the bill lightly and so rapidly that the movements of the head are barely visible giving an effect much like the roll of a drum. After every few seconds the bird pauses and looks round expectantly as though awaiting an answer or the arrival of its mate. The same branch is resorted to time after time and will be found to be almost unmarked, the whole action being very different from the slow, heavy strokes employed when a nest is being excavated or grubs dug out. While apparently a mating call in its origin, drumming may be heard throughout the year. The species which I have seen in the act are *Chrysocolaptes guttacristatus*, *Brachypternus benghalensis*, *Micropternus brachurus* and *Yungipicus hardwickii*.

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REVIEWS.

I. A GAME BOOK FOR BURMA AND ADJOINING TERRITORIES, by E. H. Peacock, Deputy Conservator of Forests and Game Warden, Burma (Retired), 292 pages, with xxvi plates, sketches, and a map. H. F. & G., Witherby, London, 1933, price, 12/6.

The best way to commence this Review appears to be by quoting from the Foreword by Mr. C. W. Hobley: 'A Book of the character provided by Mr. Peacock was badly needed, . . . His main difficulty has been one of compression. Visitors to Burma, whether for sport or for nature study, will find this book a mine of information, all well arranged.'

Those who have visited Burma in recent years—as did the present writer—have indeed felt the need of such a book as this. To follow this work there is need for an Angler's Book for Burma, on the lines of *The Rod in India* by H. S. Thomas, for the country in its hilly regions is an Angler's Paradise.

The author accurately describes Burma as hard to equal from the point of view of a sportsman with naturalistic tendencies; and it is to be hoped that this book will attract visiting sportsmen of the right type the presence of whom in the forests is a check on poachers, and their methods an example to the people of the country.

It is sad to read that the Javan Rhinoceros—the Lesser One-horned Rhinoceros (*R. sondaicus*) is almost certainly doomed to extinction in Burma; and that its smaller relative, the Asiatic Two-horned Rhinoceros (*R. sumatrensis*), is much restricted in habitat and also in danger of extermination.

The appointment of a Provisional Game Warden for Burma was attended by many good results; and it is urged (with small hope of success) by all who know the subject well that in most Provinces in India there should be a Wild Life Department. Game and Wild Life Associations do much good, but only by means of a Government Department can protective measures be co-ordinated and have the desired results. That the post of Game Warden in Burma has been abolished is very much to be regretted.

Reading of 'Plans and Preliminaries' the intending sportsman will find all the information he requires. One thing only is omitted—the best method of keeping off leeches! The writer can say that woollen stockings, over which cotton stockings, and a high felt spat damped with kerosine, will afford immunity from leech bites even if it be necessary to wade through water.

Those with experience will concur with the author's choice of rifles (p. 40); but few will agree that a return to the 8 and 12 gauge black powder rifles of their early days can be viewed with equanimity. The ·577 black power magnum rifle, however, has scarcely been surpassed in practical efficiency by any of the modern H. V. weapons.

Writing of cameras and photography the author gives much practical advice, the result of experience—the reading of which would have saved many, this writer for one—much avoidable expense. The results obtained by the author are not equal to the expert illustrations in some recent books; but as he says, his are the first to appear in a book of wild life in Burma: and they are much in advance of what most amateurs have achieved.

In Tracking and Still-Hunting, the reader travels with a skilled sportsman: and in '*Preservation and Care of Trophies*' he receives much sound advice. Three pounds of the burnt alum and saltpetre mixture is a short allowance for a tiger skin: double that quantity is nearer the mark: and it should be noted that the alum and saltpetre ought to be kept in separate tins until required for use. The writer has found that, unless the circumstances be exceptional, it is not necessary to stretch a skin on the ground, or on a frame, as the skin, if spread out on the ground in symmetrical proportions, will retain that shape within fifteen minutes of the application of the preservative powder. It can then be left on the ground, or raised for airing and drying in any manner found necessary. Unburnt alum and common salt is also efficacious, and can be used in proportions varying with the humidity of the atmosphere.

Of the elephant, Mr. Peacock writes with intimate knowledge. It is interesting to learn that sharp tusks are the result of constant rubbing and sharpening. He remarks at page 89 as to measures found entirely successful in dealing with crop-raiding elephants. These could be usefully followed in parts of Southern India, and in Ceylon.

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Of the bison also there is everything that a sportsman can wish to know. There is no finer sport than the tracking up of a solitary bull bison and what the author writes of this and the similar pursuit of elephant and *Tsaine* should certainly attract sportsmen to a delightful country. The photographs give excellent impressions of these animals. The intending sportsman is, very properly, carefully warned to avoid shooting immature bulls or cows of bison and *Tsaine*. It may be added that sportsmen without experience should try and arrange a visit to the Pidaung Sanctuary to there see bison and *Tsaine* of all ages and learn to distinguish them.

One would not go to Burma for buffalo, the heads obtainable in India being larger and without suspicion of the animal having run wild. Anyone desirous of adding the horns of a thamin stag to his collection, or even of seeing these beautiful deer in the wild state, should pay a speedy visit to Burma, for this species is fast disappearing from the country. When the writer was in Burma over forty-two years ago thamin were exceedingly common in all suitable localities, and even now some few of the thousands of former days may be seen near Shwebo; but their time is not long. As the author says, thamin shooting in forest reserves should be entirely prohibited, and sanctuaries established to preserve them from extinction. So also with hog deer.

There are chapters on the Malayan sambur and on barking deer. Of the former the opinion is given that these are quite the hardest deer to photograph on foot. And attention is drawn to the peculiar bare hairless patch to be found on the throat of every wild sambur in Burma, the cause being probably a parasite peculiar to Burmese forests. Here is something for one of the 'ologists' to identify and explain.

Of other animals, Serow and Goral,—good photographs of these,—takin, wild pig, tapir, jackal, wild dog, mouse deer, are dealt with. Then there are chapters on the Himalayan black bear, the Malay bear, and the clouded leopard. Judging by the measurements and weight given, the Himalayan black bear of Burma is a smaller animal than the inhabitant of the Himalayas of India, where a large male will weigh as much as 380 lbs. and measure over 6 ft.

The author remarks that he has never known panther or tiger baits to be found or killed by wild dogs. In India such incidents are within the experience of a number of sportsmen.

The chapter on the tiger contains much of interest. The weight of a full grown tiger is underestimated at 400 lbs. and that of a tigress overstated as 300 lbs. The latter would be an extra large beast and 420 to 450 is the weight of the majority of tigers. The author truly remarks that in their writings many sportsmen of Indian experience have merely repeated observations of others without offering facts within their own observation. An instance is the common statement that tigers do not eat carrion, or the kills of other animals. This, as the author remarks, is far from the case. It is only by written notes taken on the spot that one can declare positively as to such things as the method of a tiger in killing, the extent of his appetite, whether it is the tiger or tigress which discards the tail of a kill or devours it, the direction of the wind in connection with sense of smell, and other matters requring elucidation.

'Tigers do not attempt to cover their kills with leaves and grass in the manner of a panther'. That may be so in the dense forests of Burma, but tigers in India often cover kills in this way. 'In Burma tigers almost invariably break the hind legs of large buffaloes and bullocks before attempting to kill them, . . .' In this also tigers of India differ, for the breaking of the hind legs of animals is most uncommon. The author is of course quite right in stating that tigers do not kill animals in a uniform manner. He is likely to be alone in his statement that the 'tit' of the tiger is in imitation of the sambur alarm call. He remarks, however, that the question remains an open one.

Those who have done much sitting over kills at night know that tigers make many different sounds. One that is not noticed is that very cat-like call made by a wounded tiger or tigress when on the point of dissolution. The experience of the writer is that tigers are not so silent in their ways as the author remarks.

Two pages of very interesting matter are given to the subject of the power of scent of the tiger. Mr. Peacock's views are moderate. Various writers pro-

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ceed to one or other extreme on the subject. The late Mr. Abel Chapman wrote that a lion will accurately locate the position of an intended victim at a good half mile. He was of opinion also that wild fowl, teal especially, are keenly alive to the faintest clue from scent: a statement not borne out by the test of experience. Mr. Dunbar Brander writes that the tiger has hardly any sense of smell. The tiger has no doubt more sense of smell than many will credit him with. A large series of accurate observations, made with a testing of the wind on each occasion, is necessary to support positive assertions on the matter.

It is remarked that the sense of smell of a panther is more highly developed than that of a tiger. Perhaps the many occasions on which the writer has shot panther from a hide on the ground are no evidence of want of power of scent on the part of the panther, but due to his familiarity with the habitations of man and the smell of the human being.

Has anyone ever known a case in India of an animal being fed upon by a tiger when alive? That, surely, must be peculiar to the tiger of Burma.

As to 'sitting up' *versus* 'beating' Mr. Peacock has a good deal to say. One sportsman has remarked to the writer as to sitting up over a kill that one might as well set a spring gun, or press a button at one's tent door! The same sportsman would shoot a tiger from his perch in a beat when he had done nothing towards the rounding up of the tiger except sitting in the place he was told. The fact is that to arrive at such a pitch of perfection in one's knowledge of the habits of a tiger in respect to his kill, as will enable the sportsman to be confident of the return of the animal on the greater majority of occasions, is attained by few; for much experience in the methods leading to success is necessary.

In countries like Burma, where beating is almost impossible, sitting up is the only method; and the use of the electric torch is justified for several reasons if the tiger is to be fired at after dark: but it is true that this form of shikar engenders a distaste born of the secure success obtained by experience in such methods for: 'The sweets of destruction are somewhat tame, when no personal risks befall'. In any case the days are not far off when—in many parts of India at any rate—the shooting of tiger by night will have to be barred, as it has been for a number of years in the United Provinces.

As to photography, the invention of a noiseless flashlight bulb eliminates the objection to the very disturbing influence to game of cameras set at salt licks and water holes.

The author has never known his tiger or panther baits to be molested by wild dogs. In India such incidents are within the experience of a number of sportsmen.

Part III of the book is devoted to small game, and the information as to species and their habits etc. is useful and well tabulated. To an ear accustomed to the call of the Indian peafowl the call of the Burmese bird seemed markedly different. No writer on birds appears to have remarked this.

Miscellaneous mammals, birds, and reptiles, are dealt with in Part IV. The list is a long one. It does not seem safe in these days of the indiscriminate possession of firearms by all and sundry to say that any form of wild life is undeserving of protective legislation. In Ceylon the gunner slays anything that will go into the cooking pot, so the slaughter done by 70,000 license holders is immense; probably the 20,000 Burmese license holders are not backward as to destruction of the same description.

Part V notices the waters of Burma as teeming with fish, and the immense quantities of fish that are trapped annually as they pass to and from their spawning grounds. Many rivers in India have been almost depleted of fish by the merciless killing of everything that swims in their upper waters and tributary streams; and from what was observed by the writer in respect to the tributary streams of the upper Irrawady it is necessary that steps should be taken to prevent similar destruction in the rivers of Burma.

Mr. Peacock is much to be congratulated upon his most useful and well arranged book.

It is noticed that in the Map of Burma the railway lines from Thazi Junction to the Shan States on the East, and to Myingyan on the West, have been omitted. And it would have been as well for the several Game Sanctuaries mentioned in the book to have been indicated on the map.

R. W. B.

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II. NIDIFICATION OF BIRDS OF THE INDIAN EMPIRE by E. C. Stuart Baker, C.I.E., O.B.E., F.Z.S., etc. Vol. II. *TURDIDAE-STURNIDAE*. Taylor & Francis, London, May 31, 1933. Price, 30/-.

The present volume deals with the whole of the birds included in vol. ii of the *Fauna*, with the exception of the *Cinclidae* (Dippers), the nidification of which was described in vol. i of the present series. It also includes the *Irenidae* (The Fairy Blue Bird), *Oriolidae* (Orioles), *Graculidae* (Grackles and Stares), and *Sturnidae* (Starlings and Mynas), which come into vol. iii of the *Fauna*.

As noted by Mr. Stuart Baker in his preface, the total number of species and subspecies dealt with in the book under review amounts to 540, of which 13 have been described or resuscitated since the publication of the *Fauna* nine years ago.

Of this number, seventy-five birds do not breed within the limits of the Indian Empire, and of the remaining 465 species and subspecies the nidification of no less than 403 is now described, the percentage being roughly eighty-six as against fifty-five included in Hume's *Nests and Eggs*.

The sixty-two of which nothing is so far recorded are mostly birds which breed in the higher Himalayas or the extreme East and South of Burma, so that field workers having access to these localities still have scope for much useful work.

Apart from those of which nothing at all is known, the nidification in some cases requires confirmation, and in others only a single nest and eggs are recorded, and although the authenticity of such unique specimens is not in question, the desirability of further material is obvious.

A case in point is the race of *Acrocephalus stentoreus*, the Reed Warbler which breeds on the Inle Lake in the Southern Shan States. Although Mr. Livesey has taken a number of nests and eggs, the exact status of the bird is still in doubt.

Similarly, the Bush Warbler of the genus *Horeites*, which occurs in the Shan States and is not uncommon at Maymyo requires identification. The bird is a great skulker, breeding in dense tangled undergrowth, and I remember Harington telling me that he had obatined both birds and eggs after endless search, but neither the eggs nor Harington's notes appear to have been available to Mr. Stuart Baker.

Such instances can be multiplied, and are cited, not in a spirit of criticism, but to draw attention to the fact that, despite the immense advance in our knowledge of breeding habits that we owe to Mr. Stuart Baker's labours, much still remains to be discovered by the enthusiastic ornithologists of the present day. To name but one locality, with which I am personally acquainted, there are still many discoveries to be made in the evergreen forests and mountainous regions of South Tenasserim.

Bearing in mind the extreme rarity of many of the birds dealt with in the present volume, and the inaccessibility of their breeding haunts, it is impossible to express in words one's admiration for the immense mass of material that Mr. Stuart Baker has collected and collated.

Moreover, in addition to that scrupulous accuracy of scientific detail that one associates with all his work, the information is imparted in that felicitous style that one has long been accustomed to associate with the author's writings. Far from being a dry catalogue of scientific data, the whole book is pre-eminently readable, and will revive many happy memories for those who, like myself, are no longer workers in the field.

The book contains six beautiful photographs, the work of Capt. and Mrs. Bates, and one hopes that Mr. Stuart Baker may find it possible to include even more in his subsequent volumes.

The same type has been used as in the first volume, which renders the letter press very easy to read, and I have failed to detect a single printing error. It is true that a few place names are misspelt, but here the fault lies with his correspondents and not with the author, and even so they are easily recognisable.

C. H.

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III. THE JUNGLE IN SUNLIGHT AND SHADOW by F. W. Champion, M.A. (Oxon), F.Z.S., Imperial Forest Service of India (Author of *With a Camera in Tiger-land*), Chatto & Windus, London, 1930, 270 pages, 95 illustrations, Price, 21/-.

More than five years have passed since we had the pleasure of reviewing Mr. Champion's former book *With a Camera in Tiger-land* (Journal of the Bombay Natural History Society, vol. xxxii, p. 775). It was the first book, illustrated throughout with photographs of wild animals in their natural surroundings, ever published about the wild animals of India. Now comes this larger, more profusely illustrated, and yet cheaper volume from the pen and camera of the gifted author. The book is wonderfully light for its size, is well arranged, and has large print.

The publication of this work comes at a very opportune time because the powerful advocacy of Mr. Champion is a much needed stimulus to recent movements in this country, and in other British Possessions in the East, towards the Protection of Wild Life which has become so urgently necessary.

In his introduction, the Author informs the reader of the objects and hopes with which he has designed the book. These are, among others, ' . . . in the even greater hope that it may raise a deeper sympathy for wild creatures: that it may give some sportsmen cause to think twice before they pull trigger on animals that, possibly, they often gain nothing by shooting; . . . .': All these he should amply attain.

In the former book there were some animals of the United Provinces forests which had not been 'shot'; among others the sambur, barking deer, wild dog, and some of lesser note but not of less interest on that account, and now these are all pictured to us by pen and by camera in their natural surroundings.

Every one of the twenty-six chapters in the book is complete in itself, and each a model of its kind, compelling thought towards that deeper sympathy for wild creatures which human beings must have if wild life is to be preserved and allowed the right to live which is the heritage of all animate things.

The author quite rightly remarks that Nature would seem to be intensely cruel, which in fact it is not. 'Yet it *is* difficult for the reasoning human being —the only animal which is intentionally cruel—to admit this. There is the snake which swallows frogs alive, or other snakes; that seems horribly cruel, and so on . . . However, let all who ponder on the cruelty of Nature, the inexorable Laws of Nature, read carefully all that there is in this book, especially the last chapter "The other side of the picture".'

Now let us pass the book in review. The first chapter reveals the literary talent of the author who could, if he wished, be famous as a writer of short stories! In this there are lovely pictures of elephant and sambar; and that of the hyaena brings to memory the many occasions on which the furtive purloiner of others' dinner went off in just this way with a joint from the kill of tiger or panther.

Next comes a life-like description of a tiger at home. Every word of this chapter most vividly portrays the life of the forest creatures. Only one who has held many an all-night vigil in the jungle could write with such intimate knowledge as this.

After the Tiger, the Pangolin, a creature seen by few. The present writer once found a dead pangolin in the Ganges Kadir, a victim apparently of snake bite. It was 3 ft. 10 in. in length, tail 1 ft. 10 in., tongue 14 in., centre claw 3½ in., weight 29 lbs. and obviously full grown. One sometimes meets with dead pangolins in the jungle, apparently killed by panthers. The chapter gives much interesting information and is illustrated with five perfect photographs of this peculiar animal.

Quite true! The tiger is not a cruel beast; he kills because he must in order to exist. Perhaps his early efforts are cruel—to our ideas—but they are not intentionally so; and it is a fact—as those of us who have experienced sudden and extensive injuries, broken bones, maulings by tiger or by bear, can testify—that the shock of the impact deadens all pain. Yes, the human being *is* cruel —think of all the creatures condemned to life-long imprisonment behind the bars—the tiger is not. Hand in hand with game preservation should go a sufficient measure of protection to the greater Carnivora.

Now the reader is in the forests of Oudh. He sees the stately Sarus crane.

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its sonorous cry is now heard in Whipsnade Park! Also the foxes, the crocodiles, the pythons, just as those of us who have had the fortune to know those forests have seen them in their native haunts. All is so readable, so vividly true, so full of 'meat'! And then the few forceful lines of wild life propaganda at the end of it; and of other chapters also.

The question as to why the horns of the numerous sambur stags of those forests are so poor in comparison with those of the Central Provinces is considered, and various theories are discussed. It cannot be that the flatness of the Oudh forests has resulted in the production of a local race with a tendency to produce small horns, as the sambur of the Himalaya, which are found at an elevation of as much as 9,000 ft., can show no better heads. The sambur of South India, hills and plains alike, have comparatively small horns; so also in Burma, where the horns generally are not much better than those of Oudh; and in Ceylon where the horns of both sambur and spotted deer are small in comparison with those of the Central Provinces. In parts of Central India sambur horns tend to become abnormal both as to thickness and number of points. It is a baffling problem, and can be considered in respect to other animals—black-buck for instance—the horns of which are smaller in the south than in the north, chinkara too.

Now the Ratel; another animal seldom met with. The writer has only seen two in forty-three years' of jungle jaunts; once in Kheri, once in Hoshangabad. There is a most interesting account of this animal, with five excellent pictures. All will be grateful to the author for this chapter and that on the pangolin.

Space does not permit of more than a passing mention of 'A Winter's Morning in the Khotri Doon'. Pictures of pig and panther, and all about the monkeys and birds; the pheasants and the leopard cat which stalks them; and the serow standing immovable as a statue on the edge of the forest in the fading light of the dying day.

'What is the use of the leopard'? It is good to read some words of praise of this indomitable beast, and not the abuse of some writers who describe him as 'a perfect swine', 'to be killed by any possible means', and so on. There are sound reflections upon the balance of nature and need for some protection of the Carnivora. Of course if the game is not protected the Carnivora soon finish off the diminished stock and then take to the cattle and the people, to finally disappear from that part of the country. This has happened in several parts of India now denuded of all the larger wild animals. The time has certainly arrived in many parts of India when all shooting of every description should be stopped for a period of years. In others there should be protection of the Carnivora and in others the protection of certain species only. Throughout the Indian Empire shooting by night should be prohibited and the use of the motor car as a direct aid to destruction of wild life be most drastically dealt with. In fact what is wanted in all the Provinces of India, and in Burma, is a Department for the Protection of Wild Life: then perhaps something may be done. But we seem to have strayed from the forests of Oudh! There is a striking description of 'Drought in the Jungle' and a story of an elephant in the same connection.

Of the many lesser cats of the forests three are illustrated; the Common Jungle Cat, the Leopard Cat, and the Fishing Cat; and much of interest related about them. It is not said that hybrids of the first-named species with the domestic cat are not uncommon, and that hybrids of the domestic-cum-leopard cat are not unknown.

The author asks for explanation as to why the jackal should make such an appalling noise at night—'throughout the silent watches of the night'—But does this concert not occur mostly in the early hours of the evening, with a complete cessation from about two hours after dark to an hour before dawn? And may it not be that the howls are to call together scattered members of the band of prowlers for the nightly search for food? and again to collect friends and relations near the break of day?

The chapter on Swamp deer is beautifully illustrated; yet not to the satisfaction of the high standard of the author.

Mr. Champion remarks that the animal photographer is as scarce as he was ten years ago. There are several reasons for this. One is that the equipment is expensive and it is difficult to know where to get it. The writer of this review has struggled with many difficulties and not yet succeeded in obtaining

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necessary apparatus. Last year in London no dealer could be found who could supply a flashlight equipment! Now, by such ingenuity and manual dexterity as he possesses the camera with a suitable lens will be fitted by himself with a synchronizing arrangement to enable pictures to be taken by the light of the noiseless Sashalite bulb. It remains to be seen if there will be any result.

What is wanted is a Handbook, of not too technical a nature, to place the aspirant to this fascinating pursuit in the right path. Perhaps Mr. Champion will write such a Manual? It would convert many users of the rifle and save the lives of a great number of animals; for it cannot be gainsaid that the photographing of an animal is infinitely more difficult than shooting it: and is a very high form of sport.

'Freedom *versus* Captivity': with charming pictures of nilgai and chital and one of a bear. All who have intimate acquaintance with the jungle creatures will agree with the author that they do not live a life of terror. Most certainly they would not be, and are not, happier caged. There is great cruelty in caging animals and birds—especially the Carnivora and birds of prey—yet, although nine people out of ten will admit this, the thing goes on; and if you write an article about it it will not be accepted, 'because you are attacking an established institution'—the 4 o'clock feeding of the lions!

Chapter 13, 'Curiosity in Animals': and we are only half through the book. Read and enjoy; also learn. And pass on to 'A Foot-hill Stream' and see how much is due to the patient Balmati and her mahawat. That flashlight work is expensive. Ten rupees for each 'shot'!

'Bhaloo the Bear' and all about him. It does not seem likely that the sucking of paws by the sloth bear is a salve for bruised feet; for the baby bear one keeps in camp sucks his paws in quite a grown-up manner. The idea that he gets a taste of salt may be an explanation of the habit. Those four lines at the end by W.J.K.S. excellently describe Adam-zad, the bear.

'The Ganges Forests' must be but briefly referred to. Here again the faithful Balmati has been invaluable and given us lovely pictures of 'elephant children'; and what a unique picture is the flashlight photograph of the sloth bear with two cubs on her back.

'Jungle Camouflage' is instructive; and an excellent article on a very large subject. To which of the eleven or twelve known members of the genus krait does the remark of the danger to which we are constantly exposed from the 'inconspicuous dust coloured krait' refer? The Common Krait is the krait of the United Provinces and is a conspicuously marked snake having linear white arches, more or less in pairs, on a blueish ground. The author is so consistently accurate that he will excuse this small matter being noticed.

An Indian Hill Station in the Monsoon can be very dull to many people; but, as the author points out, some people never see birds, insects, or butterflies. He illustrates somd of the creatures one can see, and one not likely to be seen unless specially looked for. The handsome Himalayan Flying Squirrel can be seen at dusk if it is known what tree they inhabit. That is the difficulty. Natives watch them parachute down to the foot of a tree and kill them with sticks. It was a wonderful feat to obtain the photograph that we admire. Are Station leopards half starved? A number shot at Chakrata and Ranikhet were of the usual weight. One carried along in the early morning was heartily cursed by the langoors.

'Hyaenas'. That is quite right about the hyaena. He was not created to fight, so why dub him cowardly? Speaking for himself the writer has never come across an instance of a hyaena driving a panther off its kill. The author has never heard the cry of the hyaena. He is right in saying that it is a very silent beast but it will utter the sound, well described by Dumbar-Brander as a 'sort of chattering laugh', when disputing a feast with another animal, a pig for instance. As remarked in former reviews the hyaena when hard pressed for food will kill adult women and big children.

'The Senses of the Tiger': with two excellent photographs. Many watchers in machans have no doubt heard and sometimes seen, as one might express it, unsuccessful sniffs as the tiger searches around for taint of man. All with the necessary experience will agree that the tiger has a poor sense of smell; yet that incident in the Pidoung Sanctuary, related in a former Review, rather shakes one's opinion. The tiger's sense of taste is a very preverted one to our ideas as he will eat a kill which is more 'rice' than meat! and he will

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quite often annex the kill of a panther, and sometimes of another tiger, if he comes across it on his rounds, though on those occasions he seems just to take his fill and pass along with no intention of returning to the easy feast.

It is good to read that the Siwalik Hills are still 'a happy home for countless numbers of God's wild creatures', as one thought that the animals and game birds had been sadly thinned out by the inhabitants of Dehra Doon Cantonment. A very good photograph of the Siwalik's, a quite perfect flashlight of a tiger, and a stag chital apparently in velvet.

Chapter 22 and the Sixth Sense. That article in *Blackwood's Magazine* for July 1931 was very intriguing. The writer drew the attention of 'Kim' of the 'Statesman' to it but was unable to follow the subsequent talk. There is no doubt some sense, apart from the five senses, which informs a human being at any rate of someone being close by. That was shown to the writer only last month. A sandy river bank and two Irulas, he of the tousled hair lying prone while the other deloused his head. The interesting operation was watched for fully a half minute. Then the operator looked up suddenly to find the white man standing within six feet of him. Some sense apart from the ordinary five must have told him of this. So it may be with animals. The writer has certainly had warnings of danger in the way of accidents and learnt not to disregard them. As Shaik Badulla of Orrcha used to say: *'Jab dil bolta jaunga; jub dil nahin bolta kabhi nahin jaunga'.*

Now read all about tiger tracks and study the matter with the aid of the photographs; and then about the kill being on the left side or the right side; and the direction in which the head is pointing; and kills in the open. There are more of these sort of beliefs not mentioned by the author. If the tiger you have shot has his tongue between his teeth then you will be again successful in a day or two; and the number of lobes in his liver will tell you his age; and some more of the same kind, including a new one told to the author by a jungle man.

Do tigers eat carrion? The answer to this is in the affirmative, as they say in the 'House'. In the Upper Chindwin country it is usual to put out the carcase of an animal if you want to shoot a tiger; also see previous remarks.

There are other 'Jungle Riddles' discussed in this chapter and the next, and perhaps by writing about these the author may attract to the pages of our *Journal* interesting observations on all these matters by Members of the Society.

Your reviewer would like to say that he is not a famous hunter and is in agreement with all the author says as to the alarm calls of the langoor. That is it; the pitch and the violence will tell one the true alarm from the false: and in connection with alarm calls is it not possible to say from the tone of a sambur's call that the alarm is caused by a tiger or by a panther? That is what the present writer thinks he can quite frequently distinguish.

Chapter 26 discusses 'The other Side of the Picture' with, incidentally, pictures of chital, panther, and a sambur hind; also two good reasons why the jungle need never be lonely.

The whole of this chapter should be read and re-read; and further than this it may be said that this book should be where it can be often taken up and looked into, for in it is all that a lover of nature, or one seeking enlightenment, could wish to have to inform and guide him.

This Review seems to have come to a great length. Has it been too appreciative? Possess the lovely book and judge for yourself and you will be grateful to Mr. Champion for having written it.

R. W. B.

IV. The BOOK OF THE TIGER.

It is with much diffidence that I comment on a review in this *Journal* (vol. xxxvi, No. 3) of a book of my own, but there is a precedent on page 209, vol. xxx, where the author of *Wild Animals in Central India* has replied to some criticisms of his work. I have myself reviewed many books and am sensible of the difficulties of the reviewer, as he is of those of the author. All that the author can ask of the critic besides accuracy and discrimination is that he should be as well equipped as, or better than, himself to deal not only with a part but the whole of so vast a subject, involving an extensive field

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of research besides the experience of the field naturalist, in which capacity the reviewer speaks with unrivalled knowledge and experience that I cannot for a moment claim. The reviewer has also to take into consideration all that a book contains, and not merely occasional omissions or isolated items on which, moreover, a light may be cast by other and perhaps unnoted passages, as for example on the senses and on colouration in Chapter I, in addition to Chapter II of my book.

The Book of the Tiger is not intended to be a scientific treatise, but merely, as stated in the Preface, to 'present a comprehensive view of the animal', with so much detail as is essential to offer a general idea of its nature and habits, and not an exact description of every attribute and action. It is of necessity largely dependent on the accumulated experience of many observers over a prolonged period, which is in the nature of things more extensive than that gathered by a single individual, although the experience and opinions on the subject of different people must have different values. One who has, in years long gone by, made occasional visits to jungles cannot possess the obvious advantages of prolonged residence in the wilds and of resources in information and personnel available to Forest Officers, of which such excellent use has been made by Messrs. Dunbar Brander and Champion, who have in their books depicted every movement of the tiger in description or in photographs.

In writing such a book one may omit many things mentioned elsewhere in one's own publications or in those of other authors, some perhaps being too trivial to notice. I must refer to a few passages in the review which need not vitiate the value of the whole any more than, as the reviewer kindly says, the reader from his criticisms 'might wrongly conclude that the book is of little value'. With regard to the complaint that I have not 'pronounced judgment', I certainly would not do this dogmatically concerning points which embody not only facts but theories, or where action or habit is not uniform but varies with circumstances. In the first category are theories relating to evolution and colouration, and in the second the tiger's methods of hunting and killing. Has the time yet come to settle finally such things as the uses of the senses of hearing, seeing, and scent, or the proportion of the sexes? On many matters, including that of the length of tigers, I have reached the same conclusions as the author of *Wild Animals in Central India*.

There is no 'effort to be original' in the suggestion that 'cleanliness in a beast of prey may reduce the probability of detection by scent on the part of a prospective prey'; the remark is not original, but is that of a scientific naturalist who specialised on the *Felidae*. It may be fantastic, but is given for what it is worth. The reviewer asks: 'Who can say what the powers of vision of animals are at night?' It may be added, 'or by day?' As remarked in my first chapter, 'the structure of the visual organs of the tiger is adjusted for hunting by day and by night', and surely we can advance some speculative suggestions as to what is beheld by the eye, whose structure is practically identical in all mammals, including man, although in the *Felidae* and some other animals a brilliant pigment increases the powers of vision, especially in a feeble light. The question is less one of sight than of perception, a matter dealt with on pages 123-124 of my book. The tiger's reason for hunting by night when 'the animals he hunts are on the move themselves' is clearly indicated in my remarks on nocturnal habits on page 115.

As for the length of tigers, enough is as good as a feast. I have purposely omitted many 'records', including that of Satunin referred to by Professor Pocock on page 522, of vol. xxxiii of this *Journal;* the Russian naturalist, we are told, states that he saw in the flesh a Transcaspian tiger whose stripped skin measured from the tip of the nose to the *root* of the tail 11½ ft. Perhaps there is a mistake in translation, *koren*, root, being confused with *konchik*, tip, or *konetz*, end.

The reviewer has read part of the book with insufficient care. I did not, as he says, 'predate the entrance of the tiger into India to 5000 B.C., a conclusion based on the finding of a single coin.' I predated the entrance 'as far back as 5,000 years ago' (not 5000 B.C.), based not on the finding of a single coin, but of a number of seals engraved with figures of the tiger found in the 5,000-year-old ruins of the city of Mohenjo-Daro in the Indus valley.

I am not surprised that the reviewer is astonished at the '200-lbs. of beef eaten at a sitting'; this is an error in printing or transcription. The original

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manuscript gives 100-lbs., which is perhaps excessive, although it is said in *Wild Animals in Central India* that a tiger will eat 'three-quarters of a fair-sized buffalo at one meal'. I regret that my careless proof-reading should have put the reviewer to the trouble of writing ten lines on this matter; and that he has found it necessary to write fifteen lines because I overlooked a third instance of two tigers being killed with one shot.

My chapter on 'The Lion in India' is obviously a sketch and not an exhaustive monograph. The reviewer says that I make no mention of the records of lions shot by the Central India Horse near Goona. I have on page 278 referred sufficiently to these records in what I was told by two of the most famous Central India Horse sportsmen of those days. He adds that my views as to the disappearance of the lion from its former haunts would have been welcome, my views are expressed on pages 70, 272, and 280.

Finally the reviewer refers to the 'proud title' of *the Book*. The italics are his, not mine. The title is not one of pride; it was adopted as convenient and appropriate for a companion volume to Sir Alfred Pease's less comprehensive work, *The Book of the Lion*.

R. G. B.

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MISCELLANEOUS NOTES.

I.—NOTES ON THE COLOURATION OF THE WHITE-BROWED GIBBON (*H. HOOLOCK* HARL.).

Reference: Mr. Charles McCann's notes on the Gibbon in vol. xxxvi, p. 395 of the 15th April.

I enclose notes by Major W. B. Shakespear, Commandant of the Military Police Bn. here, on a Hoolock of his. They may be useful as confirmation. On account of its colouration the Hoolock was considered a male until it changed to grey, or rather began to change, last cold weather.

"Our Hoolock when we got him (her) in late July 1927, was a greyish colour, gradually changing to jet black until about five and a half years old, when greyish patches were again visible. At six years old the whole body is of a greyish tinge, the hair next to the skin being a deep sandy shade. The big fangs (canines) came through between five and five and a half years. (Aijal, August, 1933.)"

1st. Assam Rifles,
Aijal, Assam.
August 23, 1933.

J. F. PEART,
Captain.

II.—DAILY FLIGHTING OF FLYING FOXES (*PTEROPUS GIGANTEUS* BRUNN.).

In a note in vol. xxxv, pt. 3 of the *Journal*, a Gurdaspur correspondent suggests that Flying Foxes travel long distances daily. I can add two instances of this habit.

On the occasion of my first visit to Kulu in 1910, I was told that Flying Foxes which were believed to roost in Mandi invaded Ujji, that is Upper Kulu every night in the fruit season. The apple growers dealt with them by stretching wires among their fruit trees and also by shooting them when conditions permitted.

Another instance of considerable daily flights by Flying Foxes occurs on South Sentinel Island, to the north-west of, and 17 miles distant from the Little Andaman which is barely visible on the horizon. A large colony of these bats shares a Box and Cox existence with an equally numerous colony of Pied Imperial Pigeons. At daybreak the pigeons start off for the Little Andaman in small and large parties which continue to succeed one another for 30 to 40 minutes. During the last 30 or 40 minutes of daylight they return in like fashion. The moment the sun has set, out come the great bats and disappear over the anchorage in a long-drawn-out

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procession into the darkening east. They must return just before daylight and must have a good sense of direction for South Sentinel is a poor landmark even by day. Three times have I landed on this little desert island and each time have sworn *wallāh wa billāh* that I would never do so again. After the easy walking through the forests of the Great Andaman (always excepting the fearsome thorny canebrakes in the fresh water swamps) the going on South Sentinel is the reverse of pleasant. Through a scanty humus peep sharp points of limestone which tear one's bootleather while the undergrowth is unexpectedly resistant and is armed with cruel thorns. Innumerable fat, smooth, pink, land crabs crawl about the dry leaves underfoot and scuttle into holes in the limestone, while every 30 or 40 yards one encounters a robber crab, of the size and colour of a purple savoy cabbage and standing fiercely at bay in the gloom. These discouragements are nothing compared with the all-pervading stench of flying fox which soon drives one back to the beach. The Pied Imperial Pigeon must have a very indifferent sense of smell to be able to put up with his bat fellow-lodger. Why should either find it necessary to roost so far from their feeding grounds? I do not know what enemy they can fear on the Little Andaman.

INGATESTONE, ESSEX. M. L. FERRAR.

October 11, 1933.

III.—BISON (*BIBOS GAURUS* H. SMITH) AND HYBRIDS IN THE MYSORE ZOO.

(*With a photograph*).

In the Mysore Zoological Gardens—officially known as the Sri Chamarajendra Zoological Gardens—are some bison calves captured in the forests by men of jungle tribes. Observation is kept on a herd, and when a calf is dropped the cow is driven off and the calf taken away.

Here is a photograph, taken on the 14th November 1933 with the kind permission of the Government, in which can be seen calves of several ages.

The small one on the left is about 2 months old; the centre one, a cow, about 4 months; the little one with head down, 25 days; and the young bull on the right is one and a half years of age.

It was very interesting to see these animals of different ages and observe the gradual changes in colouration. The two smaller animals are males. The smallest, is mouse-coloured, and shows no sign of the white stockings: the top of the head is very slightly darker than the other parts of the head and neck. The other shows slight signs of the coming white stockings and the top of the head is darkening. The 4-months' cow has obvious white stockings and the head is getting black.

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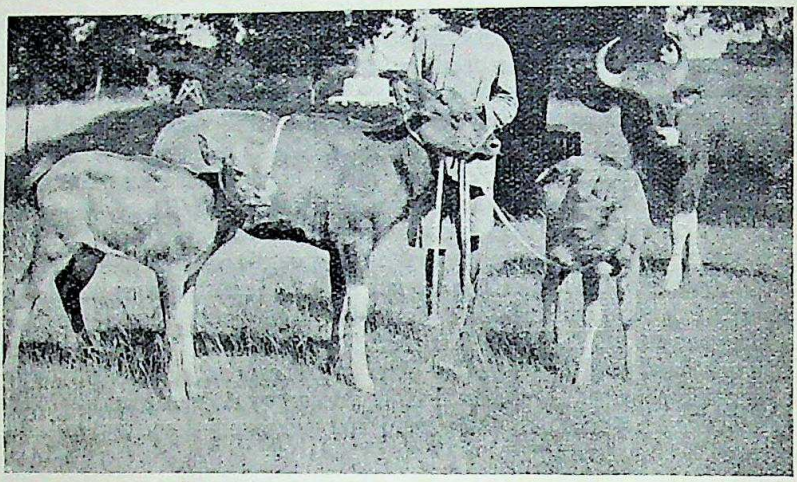
The calves have as foster-mother a domestic buffalo cow which is very fond of her charges. All the animals are in excellent condition and enjoy the freedom and grazing of open paddocks.



A domestic cow is expected to shortly calve to a bison bull. This is probably a new hybrid; a similar cross to the Cattalo of the United States and Canada.

Hybrid lion-tiger cubs are also shortly expected, and the cross between wild dog and jackal is to be seen in one of the enclosures. In one of the animals, can be observed jackal feet and tail, and in the other, the tail and feet of the wild dog, with, in each case, a mixed colouration.

Another hybrid, the making of which one can but most strongly condemn, with the hope that such an experiment will never be again attempted, is a cross between a jackal and a Cocker Spaniel. Poor terrified little smooth coated black creature. Its pleading brown Cocker eyes will haunt me for many a day. It would be a mercy to end its unnatural existence.

COONOOR.
November 23, 1933.

R. W. BURTON,
Lt.-Col., Indian Army (Retd.).

IV.—THE DISTRIBUTION OF THE GREAT PAMIR SHEEP (*OVIS AMMON POLI* BLYTH).

I return herewith your letter from the Bombay Natural History Society.

Ovis poli are found regularly in one nullah called Hak, just south of the Kilik Pass, within Hunza limits. I believe they used

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to be only casual visitors south of the Pass, but the Mir of Hunza, finding that they were much persecuted on the Chinese side very wisely gave them strict protection on his side for some years and they may now be considered to be established. There must be about 100 animals in this herd.

On the Chinese side they exist, in reduced numbers, in most of the side valleys of the Taghdumbash. I have seen them at Lup Gaz (immediately on the north side of the Mintaka), whence they must be occasional visitors into Hunza territory on the south of that Pass, and in the Kara Chukor Valley. They are still fairly plentiful in the Khunjerab and Paik Valleys and also towards Kara su and Tagharma north of Tashkurghan. Another place in Chinese territory, where I know of them, is the Muji Pami near the head of the Kashgar River.

They seem to be still very plentiful in the Russian Pamirs. W. J. Morden[1] who came out to collect specimens in 1926 for the New York Natural History Museum, told me in Kashgar that he had seen many herds all along the Russian side. To the north of Kashgar lie the foothills and main ranges of the Thian Shan. There are equally big wild sheep here but not, I think, *poli*. They are *Ovis karelini* and other varieties of *ammon*: my wife shot one near Aksu which the London Natural History Museum would have described as a new species altogether if it had not been a single specimen! Probably, there are various sub-species from Siberia to Turkestan, but I doubt whether the true *Ovis poli* exists anywhere north of Lat. 40°.

GILGIT. G. V. B. GILLAN,

March 28, 1933. *Major.*

V.—THE LOCH NESS MONSTER.

It has occurred to me that owing to the publicity which it has received a number of your readers may be interested in the 'Loch Ness Monster'. Living as I do only a short distance from the loch and possessing as I believe the confidence of your readers I endeavour in what follows to winnow the 'wheat' from 'chaff' out of the monstrous publicity which envelops and obscures this phenomenon.

It is necessary to state right away that the subject cannot be dismissed as 'Bunk' or a mere Newspaper 'stunt'. The evidence is too overwhelming for that: in fact it is the great mass of

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[1] Vide 'Notes from an Expedition for *Ovis poli*' by W. J. Morden. *Journ. Bom. Nat. Hist. Soc.*, vol. xxxiv, p. 142.—EDS.

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evidence, often quite conflicting, which opens the door to the scoffer. The animal had been seen occasionally, months before it received any publicity; and it has since been seen by a number of reliable witnesses whose testimony it is impossible to ignore. It can be taken as established that a large animal, strange to the locality, does inhabit the loch. The question then arises 'what animal'?

There is a contention that the animal is prehistoric and not known to science. The evidence in support of this is such as cannot at present be accepted by any cautious naturalist: the more improbable the event, the stronger is the necessary evidence for its acceptance.

The evidence therefore for the prehistoric animal, which in itself is weak, must, be rejected, in favour of the evidence, which is stronger, and which supports the presence of a known animal. So far no investigation has been carried out as to what the animal feeds on: but it must either be herbivorous or carnivorous and moreover an animal of such bulk must require a generous diet. The vegetation on the banks of the loch consists of bracken, some rushes, larch, Scotch pine, alder and various other trees. It is obvious that the depredations of a shore feeding animal would by this time have become apparent and there only remains aquatic plants. The loch is deep and rocky; there are practically no aquatic plants save, possibly, those in the extreme bottom; it is therefore very improbable that the animal is herbivorous. A carnivorous diet, is a much more concentrated form of food, than a herbivorous one, and of the former there is ample; trout, salmon, eels and possibly land animals which water at the loch. The loch itself drains out partly in the Ness River, and partly in a section of the Caledonian Canal: the intake to the canal is supported by a ramp or 'bund' of small height and easy slope, presenting no real obstacle to any fish or sea mammal: and the Ness River which commences below the ramp for its 8-mile journey to the sea contains ample water to carry an animal of the size and nature which on all accounts we are discussing.

It can therefore be fairly certain that some marine animal has forced its way up the Ness River into the loch and has failed to find its way out. There are two local animals which might fit the evidence so far obtained. One 'The Basking Shark' which is fairly common and attains a length of 30 feet but it is not known if this animal will live in fresh water and it is doubtful if even in its most enthusiastic moments it would face fresh water.

The other local animal is the 'Grey Seal' which in its colouration would account for the conflicting evidence as to the monster's appearance. It attains a length of 10 ft. which is ample to account for the descriptions of the beast after one has lopped a few feet for exaggeration and excitement: (*N.B.*—A few feet have been lopped off Indian Tigers!) Salmon over 7 in. is its chief diet and it is probable that a Grey Seal enthusiastically followed up a big run of Salmon into the Ness River and seeing them escaping up the river into the Loch itself, adventurously followed them up. Time will show unless some barbarian puts a bullet into it: no

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foundation at present should be placed on sensational stories as to its being prehistoric or antediluvian.

A. A. DUNBAR BRANDER.

IVYBANK, BISHOPMILL,
ELGIN, N.B., SCOTLAND.
February 9, 1934.

VI.—EXPLOITATION OF WILD LIFE (CEYLON).

The following figures are of interest and give cause for serious thought. They were kindly supplied to me by the Principal Collector of Customs, so that I can keep all my records and data up to date.

I give the figures for 1931 and 1932.

1. Skins, raw and salted, of wild animals, exported during 1931 and 1932.

Nature of skins.	Weight.	Value.	Weight.	Value.
	Cwts.	Rs.	Cwts.	Rs.
Crocodile ...	176	24 300–	232	39 100–
Talagoya ...	24	13 500–	168	39 000–
Python ...	2¾	1 433–	23	14 800–
Reptiles, snakes ...	28	1 325–	25	8 600–
Mixed skins, (?) ...	353	58 000–	324	49 100–
Leopards ...	17	3 265–	23	7 005–
Totals ...	600¾	101 823–	795	157 605–

There is no export duty on these skins.

Note.—Taking the average weights for the skins at a high figure, we get the following truly amazing number of wild animals killed and destroyed, to suit a whim of fashion! These were *killed*, how many were left wounded and died?

Crocodile. At an average of 10 lbs., means that in 1931, 1,936 of these animal skins were exported. In 1932, some 2,552 crocodiles were killed for this export figure alone.

Talagoya. 1932 figures show an increase of some 4,000 of these useful animals having been killed, as compared with figures for 1931.

Python. At an average of 8 lbs., 322 pythons were killed in 1932, against some 37 only in 1931.

It is difficult to estimate, or even guess at the total of snake skins needed to make up one hundredweight, perhaps 50? At that figure, in 1932 alone some 1,250 snakes were killed to supply the skins exported.

Leopard. At an average of 10 lbs., salted and raw, gives 253 leopards represented by the export figures for 1932.

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Other figures of interest are the statements of animals exported from Ceylon, during the years 1931 and 1932. I am not aware how the 'value' has been arrived at.

Animals.	1931.		1932.	
	Total No.	Value.	Total No.	Value.
		Rs.		Rs.
Elephant	nil.	...	nil.	...
Bear	1	50-00	...	...
Deer	2	200-00	1	250-00
Palm cats	8	55-00	nil.	...
Mongoose	7	70-00	1	5-00
Lizards	41	40-00	nil.	...
Monkeys	27	245-00	30	310-00
Snakes	117	250-00	24	200-00
Pythons	nil.	...	1	200-00
Squirrels	1	5-00	nil.	...
Owls	2	5-00	nil.	...
Frogs	51	10-00	nil.	...
Porcupines	2	15-00	1	10-00
Peacocks	nil.	...	2	200-00
Wild cats	nil.	...	3	15-00

1931. 259 wild animals, representing a value of Rs. 945, were exported.

1932. 63 wild animals, at a value of Rs. 1,190.

No export duty on wild animals, excepting elephants.

Total value of produce of wild life, exported during 1931 and 1932, Rs. 2,61,563.

West Haputale Estate,
Ohiya.
October 1, 1933.

A. C. TUTEIN-NOLTHENIUS,
F.Z.S.

VII.—WOODSNIPE (*CAPELLA NEMORICOLA* HODGS.) IN MALABAR.

This snipe though uncommon, is stated to occur regularly during winter in the South Indian hill ranges, and several are shot every year in the Nilgiris, but I cannot find that it has yet been recorded from Malabar. It may therefore be of interest to report that I

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shot one on the edge of a large open rice stubble far from any dense cover such as this species usually frequents, on November 27, 1933, about 12 miles north of Cannanore and only 4 miles in a direct line from the sea coast. The bird was in excellent condition and weighed just under 6 oz. The skin was sent to the Society and verified.

E. G. PHYTHIAN-ADAMS,
Major, I.A. (Retd.),
F.Z.S.

NILGIRIS.
January 4, 1934.

VIII.—NOTE ON THE WHITE-CHEEKED BULBUL (*MOLPASTES LEUCOGENYS*) IN SALSETTE, BOMBAY.

While collecting in Salstte Island last week, I shot a specimen of the White-cheeked Bulbul (*Molpastes leucogenys* subsp. *leucotis*?) which has a tiny patch of orange-coloured feathers on each side of the forehead, a few millimetres behind the base of the culmen. I shot another and this too has a less distinct but similar patch.

I cannot trace any reference to this, and shall be glad if you will let me have an opinion on the first specimen which I am sending you. You may make whatever use you like of the skin.

HUMAYUN ABDULALI.

GODREJ HOUSE,
ANDHERI.
August 17, 1933.

Many thanks for your letter of the 22nd inst. It is interesting to note that birds from Persia and Mesopotamia show the same trait.

I note that you express the opinion that the birds are probably escapes. The bird is known to occur in Guzerat and there does not appear to be any reason why it should not come down the coast as other birds have done. I saw quite a number of them at Goregaon where the specimen was obtained. On the 24th of January 1932, I saw several of these birds at Godhbunder. All the birds appeared to be in prime condition. I remember seeing them at Nala Sopara too.

EHA, in his *Common Birds of Bombay*, records that a 'Sind bulbul' of his escaped and then reappeared with a mate. This was in all probability also an escape, but at present it seems to me that they have either established themeslves firmly or drifted southwards, and should be given a place in the local avifauna.

HUMAYUN ABDULALI.

GODREJ HOUSE,
ANDHERI.
August 31, 1933.

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IX.—OCCURRENCE OF THE LARGER BLUE-WINGED PITTA (*PITTA MEGARHYNCHA* SCHLEGEL) IN EASTERN BENGAL.

Some years ago, Mr. F. Field kindly gave me a specimen of the Larger Blue-winged Pitta which he had collected at Barisal, Eastern Bengal, on 19 March, 1925. It was doubtless then on migration. This is the first record for India and suggests that the range of this little-known bird may be wider than is generally realised. This occurrence should have been recorded in print at the time but for some reason both he and I omitted to send it to the *Journal* and I now make good the omission. The specimen has been compared at the British Museum and agrees well with the series in the Hume collection, except, that it is slightly paler in colouration both above and below than most of the specimens.

CALDBEC HOUSE,
BATTLE,
September 8, 1933.

HUGH WHISTLER,
F.Z.S.

X.—CATCHING OF CHIKOR [*ALECTORIS GRAECA CHUKAR* (GRAY)] IN KASHMIR.

In the last issue of the *Journal* Mr. Stirling remarks that a common way of catching Grey Partridge in Rajputana is to chase them on ponies or with dogs. After two or three flights the birds can be picked up by hand in an exhausted condition.

This reminds me of the Kashmiri method of catching, or rather poaching, Chikor in winter. Two conditions are necessary for this purpose. First, there must be a fall of fresh snow sufficiently heavy to drive the birds down to the low foot-hills; and secondly there must be level ground at the base of these foot-hills. Given these conditions the procedure is as follows. Twenty or thirty villagers scatter themselves about the face of a hill-slope with an interval of say 150 yards between each man. When everybody is in position and the hill-slope is dotted with men at various altitudes and regular intervals, the drive begins. The birds are put up, fly a few hundred yards, settle, and are then immediately put up again by the nearest villager. At each successive flight the birds get lower and lower, and at last descend to the soft snow on the level plain where they flounder about in an exhausted state and are easily caught.

SRINAGAR.
January 1, 1934.

F. LUDLOW.

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XI.—ON THE DISTRIBUTION OF CURLEWS AND GODWITS IN THE CENTRAL PROVINCES.

These birds are seldom seen in the Central Provinces south of the Nerbudda. All Curlews seen on inland tanks and jheels in the Nagpur and Bhandara districts have hitherto proved to be the Eastern Curlew (*Numenius arquata orientalis*, Brehm). One either comes across a solitary individual or a small flock of three or four birds. On the Mahanady River, however, Curlews are more in evidence and larger flocks may be met with. I shot specimens here in March 1925 and again in November 1929 and in both cases the birds were the Western Curlew (*Numenius arquata arquata*, Linn.). It would be interesting to note what forms are met with on the Nerbudda and in the districts north of that river, where I have had few opportunities of collecting.

The two races of Curlews are easy to discriminate; the Western form has the lower parts broadly streaked and the axillaries are white with bold streaks of blackish; the Eastern race has the lower parts finely streaked, and the axillaries are white or finely streaked with blackish.

I have only once come across a Godwit and it was a black tailed one (*Limosa limosa limosa*, L.). It was a solitary individual associating with another wader, and was shot on the Sonegaon tank, 5 miles south of Nagpur.

CENTRAL MUSEUM, NAGPUR.
December 7, 1933.

E. A. D'ABREU, F.Z.S., *Curator.*

XII.—NUPTIAL PERFORMANCE OF THE SPUR-WINGED PLOVER [*HOPLOPTERUS VENTRALIS* (WAGL.)].

Stuart Baker (*Fauna*, vi, 186) remarks that 'the flight, walk and general actions of *Hoplopterus ventralis* are very like those of the Peewit', so that I venture to put on record some remarkable antics of *Hoplopterus ventralis*, which I observed in March 1932 on a sand-bank on the Namti stream in this district. I have watched hundreds of Green and Ringed Plover in England in the breeding season and never saw anything remotely approaching this performance. There was a party of four birds on the sand. First two approached each other slowly, and then stooping their bodies until they were in a horizontal position, whirled rapidly round on their 'axes', twice or thrice, describing a complete circle. (The Peewit stoops and bows in a similar position but I never saw one whirl round in this way.) They then drew themselves bolt upright, so that they appeared to be standing erect and as it were, on tip-toe, with bodies held vertically and breasts puffed out, and in this, for a wader, extraordinary position, ran, or rather shuffled, with short quick steps side by side, exactly as if 'dressing by a

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flank' (to use the term which alone seems to describe their movements). At times all four birds were running, or shuffling, side by side in this alignment almost touching each other. Occasionally one would bob his body up and down and then square up to another bird, with a threat of a blow from his wing, but I saw no actual fighting. The Spur-winged Plover is so common, and the use to which it puts the formidable curved spur on its wing, is so little known, that I sincerely hope some other naturalist will endeavour to confirm this observation, and prove whether or not the spur is actually used as a weapon of offence in the breeding season.

MYITKYINA, UPPER BURMA. J. K. STANFORD,
I.C.S.

November 20, 1933

XIII.—EARLY ARRIVAL OF SNIPE IN THE ANDAMANS.

In vol. xxxvi, No. 2 of the *Bombay Natural History Journal* I wrote that I had shot snipe on August 28th in the Andamans. This year on August 17th I put up two snipe in one of our best beats. The birds, however, did not arrive in any quantity till the middle of September. Of course, the two birds may have been pricked birds which had remained in the Andamans throughout the year. They were strong on the wing and appeared to be in good condition.

PORT BLAIR, J. MILES STAPYLTON,
ANDAMAN ISLANDS. I.C.S.,
October 5, 1933. *Deputy Commissioner.*
Andaman and Nicobar Islands.

XIV.—OCCURRENCE OF THE EASTERN GREY DUCK (*ANAS P. ZONORHYNCHA* SWINHOE) AND THE BRONZE-CAPPED TEAL [*EUNETTA FALCATA* (GEORGI)] ON THE BRAHMAPUTRA.

On December 29th I shot 2 Eastern Grey Duck (*Anas p. zonorhyncha*) on a bil on the north bank of the Brahmaputra—one out of a pair and one out of a lot of 8 or 10.

On December 25th a Bronze-capped Teal (*Eunetta falcata*) was shot in the same locality.

DIBRUGARH, J. C. HIGGINS,
ASSAM. I.C.S.
January 3, 1934.

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XV.—DATES OF ARRIVAL OF MIGRANT BIRDS IN COORG IN 1932.

August 21. Grey Wagtail—*Motacilla cinerea* Tunstall.
August 28. Common Sandpiper—*Tringa hypoleucos* Linn.
September 9. Pintail Snipe—*Capella stenura* (Bonaparte).
September 12. Common Indian Bee-eater—*Merops orientalis* Lath. (Local migrant).
September 26. March Harrier—*Circus aeruginosus* (Linn.).
September 26. Brown Shrike—*Lanius cristatus* Linn.
September 25. Green Sandpiper—*Tringa ochrophus* Linn. (first seen but had doubtless arrived much earlier).
October 3. Black Drongo—*Dicrurus macrocercus* (Vieill.) (Local migrant).
October 5. Blue Rock Thrush—*Monticola solitaria* (P. L. S. Müller).
October 7. Forest Wagtail—*Dendronanthus indicus* (Gmelin).
October 11. Eastern (?) Swallow—*Hirundo rustica* Linn.
October 11. Indian Pitta—*Pitta brachyura* (Linn.) (Local migrant).
October 12. Blue-headed Rock-Thrust—*Monticola cinclorhyncha* (Vigors).
October 14. Indian Tree Pipit—*Anthus hodgsoni* (Richmond).
October 14. Indian Oriole—*Oriolus oriolus* (Linn.) (Local migrant).
October 26. Himalayan Blue Chat—*Larvivora brunnea* Hodgs.
October 31. Indian Great Reed Warbler—*Acrocephalus stentoreus* (Humpr. & Ehreub.).
November 1. Pied Crested Cuckoo—*Clamator jacobinus* (Bodd.) (Local migrant).
November 1. Black-headed Cuckoo Shrike—*Lalage sykesii* Strickl. (Local migrant).
November 4. Verditer Flycatcher—*Stoparola melanops* (Vigors).
November 7. Hodgson's Rose Finch—*Carpodacus erythrinus* (Pallas).
November 9. Paradise Flycatcher—*Tchitrea paradisi* Linn. (Local migrant).
November 13. Red Breasted Flycatcher—*Siphia parva* (Bechst.).
December 25. Hoopoe—*Upupa epops* Linn. (Local migrant).

F. N. BETTS.

COOVERCOLLY,

SOMWARPET.

September 13, 1933.

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XVI.—EXTENSION OF THE RANGE OF THE SNAKE *CONTIA PERSICA* ANDERS. IN THE PUNJAB.

Among some snakes sent to me from Sakessar, 4,500 ft. on the Salt Range by Mr. A. D. R. D'Abreu, Civil Surgeon, Sargodah, was a specimen of *Contia persica*, Anders. This snake inhabits Persia, Baluchistan, the North-West Frontier Provinces and has been taken at Murree; the present locality extends its range further south into the Punjab. Other snakes from the same locality were *Zamenis rhodorhachis*, Jan. and a Phoorsa *Echis carinata*.

CENTRAL MUSEUM,
NAGPUR.
December 7, 1933.

E. A. D'ABREU,
F.Z.S.,
Curator.

XVII.—A WHIP-SNAKE (*DRYOPHIS MYCTERIZANS* DAUD.) FEEDING ON THE LIZARD (*CALOTES VERSICOLOR*).

The other day at Andheri, I saw a Whip-Snake capture the lizard commonly known as the "Bloodsucker" on a wire fence. The snake caught the lizard just behind the head and held it firmly. The lizard in its struggles dropped off the wire and dangled in the air while the snake maintained its hold. The Bloodsucker was very active at first, but gradually it quietened down, its movements became feeble and were eventually stilled. As death approached the lizard changed colour from light brown to dark brown.

When the lizard stopped struggling the snake gradually moved its jaws alternately till it got the head lengthwise into its mouth. It now commenced to swallow it, hanging head downwards from the wire. The body of the victim gradually disappeared leaving the tail protruding. When the body of the lizard past the head the snake altered its position. It put its head on one of the upper wires of the fence and by contortions of the body pushed the lizard down till it reached the stomach, the snake rising higher and higher as the lizard went down. All this time I remained perfectly still and carefully followed the proceedings from about a yard away. The whole process was completed in twenty-five minutes. The interesting point is the gradual death of the lizard from the poison of this snake. Death followed in almost ten minutes after capture. It is well-known that the Whip-Snake is one of the back-fanged colubrines. It is poisonous only to its natural prey but is harmless to man. It may be freely handled and will alway give warning if it intends to bite, by opening its mouth wide before

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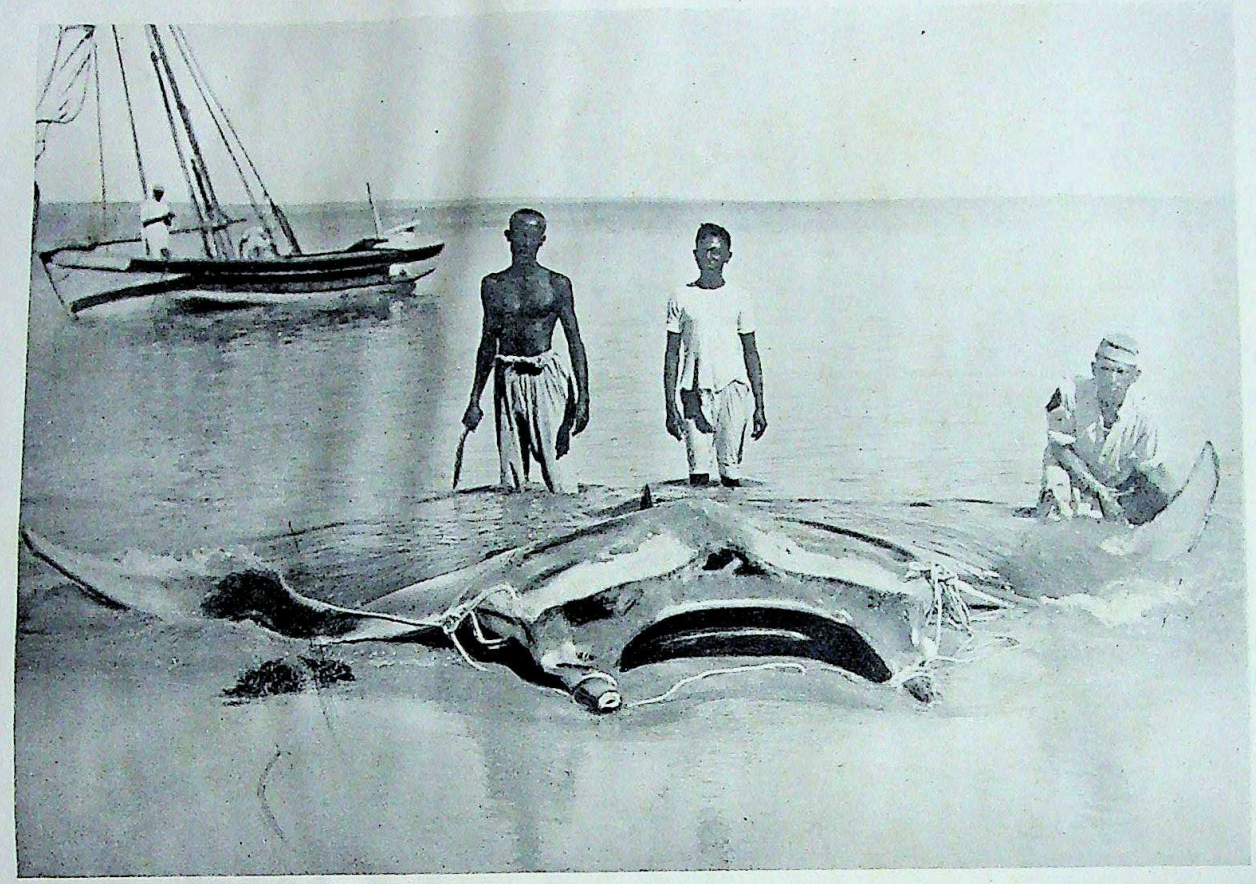

Giant Bat-Ray beached near Cape Monze.

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it does so, however, this is frequently all bravado. For the sceptic I might mention that I was bitten by the same snake while handling it and am still alive to tell the tale.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN,
BOMBAY, F.L.S.,
September 8, 1933. *Asst. Curator.*

XVIII.—BATTLE WITH A GIANT BAT-RAY (*DICEROBATIS EREGOODOO*).

On the 18th of October I left Karachi in a 3-ton sailing boat on a fishing expedition to Cape Monze, 20 miles from Karachi harbour. There were seven of us in the boat; a crew of six Indians and myself.

We had a successful afternoon's fishing off the coast of 'Kophana' where we had a good catch of the locally known 'Camel fish' (*vernacular*: 'Dun-de-a'—*Chrysophrys berda*) and, later in the evening, we moved westward and had a good bag of herrings during the night.

Before daybreak on the 19th we anchored about two-and-a-half miles west of Cape Monze, the depth at that particular place being 20 fathoms. The weather was fine and the sea fairly calm with a flood tide. Soon after sunrise all lines were out and we were settling down to our day's fishing when, suddenly, the boat took a list as if hit by a tidal wave and after a number of rolls and pitches commenced to move through the water, being towed by something invisible at the end of our 30-fathom anchor warp. I ordered all lines to be taken in by which time the speed of the boat had reached a good 2 miles per hour. Astounded at this mysterious submarine force that had suddenly taken our boat in tow I joined the crew whom I had ordered to haul in the warp. Our efforts, however, proved futile as the force with which the boat was being towed was such that I expected the 2-inch warp to part at any moment.

For the next half hour we were thus irresistibly towed towards the open sea when, suddenly, the warp slackened and the boat almost stopped. I rushed forward and hauled in a good four-to-five fathoms of the warp. At first I thought that I was to be disappointed, in as much that I would never discover what was the mysterious being that had taken us in tow, but in a few seconds the warp was jerked from my hands with such force that I was nearly thrown overboard and we continued our 'joy ride' after taking a sharp turn landwards. A few minutes later the warp came to the surface and, about fifty yards ahead of us, a body which looked like an aeroplane broke through the waves, its

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wings working with terrific sweeps. It was then identified to be a Giant Bat-Ray. So powerful was the action of its wings that it splashed water to within a few yards of the boat. Fortunately, however, the monster did not approach us for it would have involved the possible danger of severe damage to the boat. Another long hour lapsed before the Ray showed signs of exhaustion when renewed efforts were made to haul in the warp. This was eventually done by all hands on the warp with a turn taken round the thwarts and mast. Meantime, I got ready 2 harpoons, an 8-inch hook, gaffs and all the rope that was available on board.

Inch by inch the monster was drawn nearer the boat when a closer examination revealed that it was securely entangled in the anchor warp which was looped round its body, passing between its cephalic horns and near its tail. I presume that it must have hit the slack warp a few feet above the anchor and, trying to defend itself it probably lashed backwards with its tail, every subsequent movement only serving to tighten still further the knot it had tied round its body.

Another haul brought the monster within distance of the harpoons and two of these were plunged into its wings simultaneously by myself and by one of the fishermen. This was the signal for another hectic time, the Ray resuming its frantic struggles to release itself from the various ropes that were, by then, securing it firmly. The powerful movements of its wings smashed the pole of one of the harpoons and a half-inch steel hook was straightened out as if it were a bit of soft wire.

The Ray gradually lost strength and, at this stage, it was evident that there was little chance for it to escape. It eventually came to the surface and the boat being drawn close up a battle with 'kukris' ensued one of the crew diving under the monster plunging a 'kukri' into its throat.

It was my intention to tow the Ray to Karachi in order to determine its actual weight and obtain photographs showing the full outline of its body. Unfortunately this proved impossible in view of its size and the fact that it would have taken at least twelve to fifteen hours to reach harbour. We were then 23 miles from Karachi. I therefore decided to tow it ashore, the operation occupying another two hours.

Seven and a half hours after the Bat-Ray had taken charge of our boat it was landed in a small cove near Cape Monze. The tide was then running out and I had to wait for this in order to take the best photographs under these difficult circumstances as it proved impossible to drag the creature any further up the sand.

The measurements which I determined accurately were: 22 feet from wing tip to wing tip; 17 feet from head (excluding cephalic horns) to the base of the tail, and 4 feet the tail itself. Cephalic horns, of a convoluted appearance, said to be used by the animal to draw its prey into its mouth, 2 feet 2 inches. Body rough, about 3 feet thick at the maximum point. Colour of a deep grey with white patches on either side of the spine; white below. Head flattened; mouth 4-foot, opening like a huge cavern between the cephalic horns. Teeth small, file-like, extending practically the

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full length of the mouth; I counted seven rows of these on the lower jaw and six on the upper. Tail hard, very rigid and disproportionately short. Eyes, placed on the outer sides of the cephalic horns, about 3½ inches in diameter. The fishermen say that the animal cannot see straight ahead but is dangerous when attacked from the side.

This Ray belongs to the family of *Myliobatidae*, genus *Dicerobatis* and is akin to the species *eregoodoo*. I find, however, that it differs from the latter in the wings which are more elongated and narrower near the centre; also in its tail which is definitely rigid and not whip-like. I estimate that its weight must have been between 4,000 and 5,000 lbs. The vernacular name of this beast is 'Karanj', smaller ones are caught occasionally in drift nets and during the winter months are frequently seen leaping out of the water. They are more numerous in the gulf of Kutch.

RALLI BROTHERS LTD.,
KARACHI.

N. A. TOMBAZI,
F.R.G.S.

November 8, 1933.

XIX.—THE TWO INDIAN SUBSPECIES *SATYRUS* (*EUMENIS*) *PARISATIS*, KOLLAR.

Subsp. *parsis*, Le Cerf.

Subsp. *shiva*, Le Cerf.

A CORRECTION.

Comparison of the series of specimens of these two subspecies of *S. parisatis* in the British Museum (Natural History) and Evans's *Identification*, p. 113, with the original descriptions by Le Cerf (*Annales D'Histoire Naturelle, Entomologie*, 1913) shows that some confusion of the names *parsis* and *shiva* has arisen, mainly owing to inaccuracies in the details given regarding the type-localities.

(1) Subspecies *parsis* is the form having on upperside hindwing the submarginal border broad and unsullied bluish white, and the subtornal black spot 'at least partly on the white band'.

The type-locality as given by Le Cerf is 'Toba (Népaul), vii, viii, 1907 (H. C. H. Cooper coll.), W. Rosenburg, 1911 (ex coll., Eug. Boullet), in coll. Muséum de Paris: 2 ♂, 2 ♂: Types.'

This form, *parsis*, is not from 'Nepaul', but from the opposite side of North India, the mostly very dry region of Baluchistan, the Tochi Valley, Kandahar and the Swat Valley.

In Baluchistan, where (See Evans, 'Buttfls. of Baluchistan', *J.B.N.H.S.*, vol. xxxvi, p. 198, 6) the late Mr. G. E. R. Cooper

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collected on the Toba Plateau, *S. parisatis*, Brigadier Evans informs me, is one of the commonest butterflies.

Thus 'Toba (Népaul)' is doubtless an error for 'Toba Plateau, Baluchistan', as the type-locality for subsp. *parsis*, Le Cerf.

(2) Subspecies *shiva* is the form having on upperside hindwing the submarginal border narrow and more or less sullied, and the subtornal black spot either entirely or mostly in the dark area away from ('en dehors de') the white border.

The type-locality as given by Le Cerf is 'Simla (Cachemyre) (Doncaster, 1910) ex coll. Eug. Boullet, in Muséum de Paris; 1 ♂, 2 ♀: Types.'

'Simla *and* Cachemyre' would probably be more accurate, as this form, *shiva*, is from Cashmere, Ladakh, Murree and Kangra to Mussoorie, that is, the N.-W. Himalayas, a less dry region than that for subsp. *parsis*.

In the series in the Brit. Mus. are two specimens, one labelled merely 'N.-W. Himalayas', the other a female taken by myself at Mussoorie on 1 June, 1912 at 5,600 ft., which are extreme examples of subsp. *shiva*, the white border on upper hindwing being narrow and so much sullied by extension into it of the dark area that it is almost macular.

Mackinnon and de Nicéville, in their Butts. of Mussoorie (*J.B.N.H.S.*, xi) record only one example of *S. parisatis* from Mussoorie, and I met with only the one example above mentioned in some five years of collecting there.

There are in the Brit. Mus. series two specimens from the Moore coll., one a ♂ ('Kalapani, 25, ix, 85') of the form *shiva;* the other a ♀ ('Kalapani, 1, ix, 86') of the form *parsis*. It may be that the label of one of these two old specimens is erroneous. The series of these two subspecies are correctely named in the Brit. Mus. (Nat. Hist.) collection.

In Evans's *Identification* (1932), p. 113, the names *shiva* and *parsis* against the descriptions should be interchanged, and *parsis* be substituted for *shiva* in that author's Buttfls. of Baluchistan, p. 201.

LONDON.
October 15, 1933.

H. D. PEILE.

XX.—A BUTTERFLY GROUND IN KULU.

No paper, says Brigadier Evans in his *Identification of Indian Butterflies*, has been written on the butterflies of Kulu. The task is no light one, for the Kulu Subdivision is not only extensive in size but is cut up by mountain ranges the passes over which run from 13,000 to 17,000 ft. and in consequence it possesses extremes of altitude, rainfall and climate that produce a diversity of conditions which can hardly find their match in a tract of similar area anywhere else in the world. Only long local residence coupled with

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leisure and freedom of movement would qualify any individual to write a first hand account of the butterflies of Upper Kulu, Rupi, Inner and Outer Sarāj, Spiti and Lahul all of which go to form the Kulu Subdivision. I am not aware that Spiti has been properly worked and even Lahul has probably some butterfly secrets still to give up. Of one man only am I aware who could have written a paper on the butterflies of at least Kulu and Inner Sarāj; that was the late Mr. A. Graham Toung so frequently mentioned by de Nicéville in his unfinished work on the butterflies of India. But for Mr. Toung the source from which he obtained his many articles remained somewhat of a trade secret for the sale of butterflies formed an important source of part of his slender, his too slender income. The ruins of the modest dwelling in which he lived near *Bajaura* were already grassed over when I first visited Kulu in 1910. Graham Toung's secret had died with him but was accidentally discovered by me in that year. It is with some shame that I have at last summoned up the energy to communicate this secret to others.

I had started butterfly collecting two years before in Lyallpur which despite the conversion of the desolate Ganji Bār into a rich agricultural tract could still only boast of some 40 kinds of butterflies. To this number I had added another 40 or 50 during brief visits to Simla but knew very little of Himalayan sorts especially the rarer ones. In April 1910 I left on a two months' recess to visit J—C— then in charge of the Kulu Subdivision. Four new Erebias at Palampur, then *E. shallada* and *V. xanthomelas* on the Bubbu Pass with some new *Lethes* as I dropped down into Sultanpur made a good start and I passed up the Valley to Nagar hoping for great things to come. Very great was my disappointment. Perhaps nowhere in the Himalayas is there such a dearth of butterflies as on the main road from Larji to Manali, some 40 miles of Valley rising from an elevation of about 3,000 to one of 6,000 ft. In a day's march one seldom sees more than 20 kinds and those all common. I had begun to despair of doing anything much in the butterfly line when late in May my host started for Outer Sarāj where he was to meet the Settlement Commissioner. It was also time for me to move on to Simla and get to work on the report for the writing of which my recess had been granted. We decided to travel not by the hot low route via Lārji but the higher one which rejoins it at Ptach. Accordingly somewhere near the ruin of Graham Toung's house we crossed the Beas and struck into the mountains to our left and following a little stream found ourselves at Garsa rest house. The elevation I forget but it is something below 5,000 ft. After breakfast I strolled down to the stream where it formed a gravelly pool shaded by bushes. There on the wet sand I found a number of strange butterflies quite unknown to me. During the next couple of hours I caught 3 *E. dolon*, a couple of *A. ambica*, a male *Dilipa*, a couple of *Pantoporia asura*, a *Spindasis nepalisus* and, chief of all, two *Calinga budde*. Others new to me were *Lethe pulaha*, *E. athamas* and *C. thyodames*. All of these I had to search Bingham for. What a catch for a beginner! Had I had fuller knowledge I would have stayed next day

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and caught more. I did not then know that I would later search Kulu in vain for two whole seasons without finding any of these excepting *asura* in any other locality. Next day's march yielded first, sitting on the road, numerous *Dichorrhagia* and *Stibochiana* never taken elsewhere, *Sephisa dichroa* and *Pararge moorei* seldom seen again in Kulu and further on we found swarms of *Chaetoprocta* and *Euaspa* and the three common *Amblypodais*, *dodonea*, *rama* and *ganesa*. Excepting the *Amblypodias* these also were new. For the last mile before the top the road passes up the middle of a great vault formed by immense horsechestnut trees then in full bloom. As far as one could see through the forest there was an undergrowth of tall irises and the lovely six-foot *Lilium giganteum* (or is it *himalaicum*?) the whole forming a scene of beauty I can never forget. Among the horsechestnuts floated numerous *P. philoxemus*, *Delias belladonna* and a few *Aporia habellica*. After crossing the pass there was little of interest except a few Rapalas and Theclas till we came to Jibhi under the Jalori Pass. There I took several good *neptis* including *yerburyi*, *sankara*, *ananta* and *narayana*. Almost all the butterflies taken during these 3 days were new to me and my excitement was only made greater when I found how rare some of them were. Three years later I was posted to Kulu as Assistant Commissioner and twice paid visits of 2 or 3 days each to Garsa in the hopes of repeating the catch of 1910 but on neither occasion had I one quarter of that great success. Furthermore, all the rarer butterflies taken by me at Garsa were never seen by me elsewhere in Kulu in spite of much hunting throughout the seasons of 1913 and 1914. The Garsa Glen emerges as the one place in Kulu where all the rare Kulu butterflies occurring at that altitude may be found. There may be other spots equally good but they escaped my search and one may safely assume that it was at Garsa that Graham Toung got all his good things.

For the rest of Kulu and Sarāj there is little to be said. The edges and glades of the higher forests and especially the thatches or sheepfolds found here and there among them are good for *Theclas*, *Amblypodias*, *Rapalas* and such like. As is usual elsewhere the passes and open hill tops attract some of the more pugnacious of the *Nymphalidae*.

The collector should not omit a visit to Lahul which can be carried out in 8 to 10 days and will add numerous fresh forms to his collection. Once over the Rotang Pass, 13,000 ft., a new set of butterflies present themselves. The first day spent among the delicious water meadows and barley and buckwheat fields of Sissu or Kyelang will long be remembered by the newcomer for the astonishing beauty and variety of the wild flowers and for the many new butterflies seen for the first time.

I regret that I cannot add a proper list to this brief account but my Kulu collection was far from being complete and has long since been given away piecemeal or broken up. I have written from memory.

If any student of de Nicéville has ever visited Kulu in the hope of lighting on some of the many rarities recorded by Graham Toung

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he has probably gone back disappointed. These lines have been written in the hope that some collector more knowledgable than I was 23 years ago will make use of my tip and work the Garsa Glen in a good season and make a rich haul. That glen has also another wonderful memory for me. One day towards evening in February 1914 I entered the horsechestnut wood from a higher hill near by. In the next ten minutes I saw anything up to 100 Monal rising in twos and threes from all over the ground. Never was there such a show of monal. I shot 5 and stopped shooting. Why they were gathered in such strength so low down the range I cannot imagine. During two winters I shot many Monal but never saw so strange a gathering of them. Do they feed on horsechestnuts?

INGATESTONE, ESSEX. M. L. FERRAR.

October 11, 1933.

XXI.—NOTES ON OBSERVATIONS OF SOME PECULIAR HABITS OF AN ANT-MIMICING SPIDER (*AMYCIAEA FORTICEPS* CAMBR.).

(*With 5 photos.*)

It is said that hunters can detect from afar the whereabouts of a rhinoceros, hiding under thick cover, simply by the sight of a particular kind of bird (the Rhinoceros-bird, a kind of tick-bird) that always flutters overhead or follows the animal in the hope of getting food in the form of ticks that infest the hide of a rhinoceros. Though the authenticity of this story is questioned, and we are not concerned with its veracity, a curious fact, to some extent similar to the above story, came under my observation, about *Amyciaea forticeps*, an aggressive, mimic of the red-ant *Œcophylla smaragdina*.

Early in October, 1931, while searching for spiders in a jungle very close to a village in East Bengal, my attention was drawn to a flock of peculiar minute insects, hovering vertically over a leaf of a small plant, at a distance of about 16 ft. from me. I approached the spot to examine the matter closely and try, if possible, to capture some of them; I thought they might serve as excellent food for some of the young spiders that I had been rearing.

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As I got nearer, I noticed a small brick-red spider, *Amyciaea forticeps*,[1] on the upper surface of the leaf, quietly sucking the

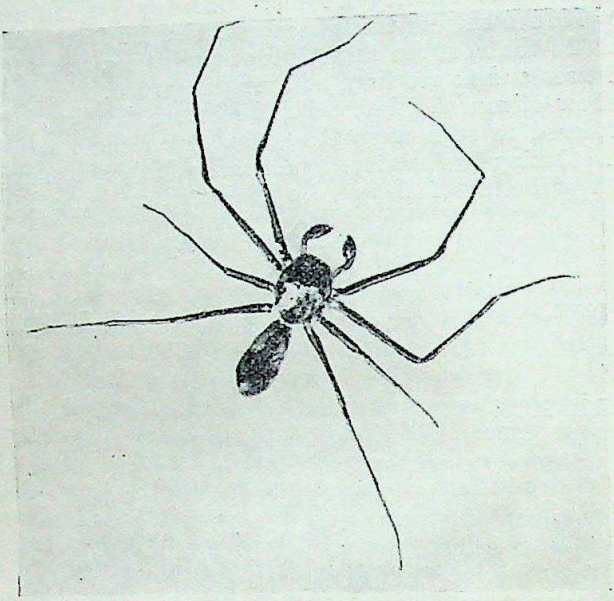

Fig. 1 a.—Enlarged photograph of *A. forticeps*, Cambr. ♂.

juice out of a red-ant (*Œcophylla smaragdina*). (Figs. 1a and b). It is rather peculiar as it has been observed in most cases that these spiders suck up juice from any one of the internodes of the red-ant and not from the abdomen which is full of juice and also easy to puncture. The insects were flying up and down round about the spider but did not dare sit upon the red-ant on the leaf. The spider seemed to be absolutely indifferent to the movements of the insects and was busy with its repast.

When I had approached within easy reach of the spider, it disappeared with such alertness in a series of rushes and pauses that I failed to follow it. The insects also disappeared. After a few minutes I saw them again flying over a twig of another plant

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[1] (a) Simon, E., *Histoire Naturelle Des Araignées, Tome Premier*, p. 986 (1892-95).
(*b*) Hingston, Major R. W. G., 'Field Observations on Spider Mimics', *Proc. Zool. Soc. Lond.*, pt. ii, pp. 844-848 (1927).
(*c*) Mukherji, D. D., 'Report on a Collection of the Ants', *Journ. Bom. Nat. Hist. Soc.*, xxxiv (i), pp. 157-158 (1930).
(*d*) Pocock, *Proc. Zool. Soc.*, No. lvi (1927).

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close to the former one. At first I did not notice the spider though I was quite near it, as it had taken shelter under a leaf, but the insects, I noticed, were moving from one leaf to another. It struck me that possibly the insects were following the spider so I followed their movements very cautiously. Some eight or ten minutes elapsed before I found the spider crawling on to the surface of a leaf, over which the insects were now flying; I then caught the spider and put it in a glass tube.

A few days later, just before the approach of dusk, the same kind of insects were found flying about something hanging in the air, which I observed from a distance of about 25 ft. The rays of the declining sun reflected from their wings, made the insects quite conspicuous even from that distance. On approaching the spot I found the creature to be the mimicing spider (*Amyciaea forticeps*) hanging from a leaf by its silk with a red-ant in its jaws. These spiders are generally very timid and afraid of the ants because of their bites. They stealthily approach the lines of the ants and when opportunity offers, snatch away a stray, weak or crippled member of the group. In this case the spider might have dropped down upon the thread for fear of the ants. The timid habits of this particular species of spider has also been observed by Mr. Kunhikannam of Bangalore.[1]

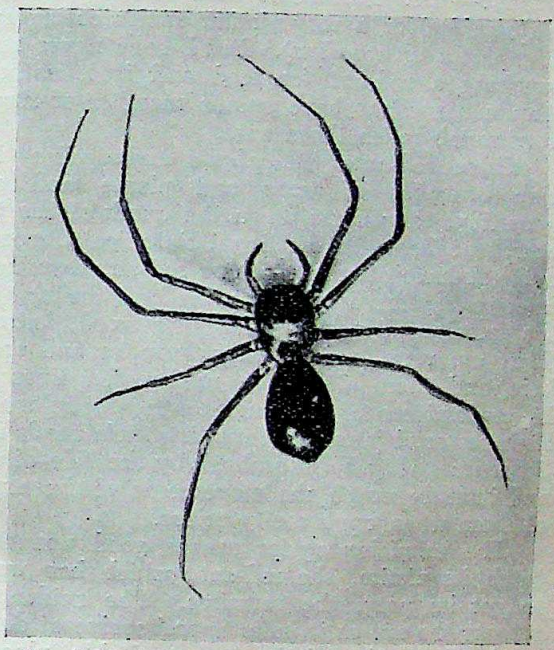

FIG. 1 b.—Enlarged photograph of *A. forticeps*, Cambr. ♀.

The insects that hover over the spiders, are in appearance like gnats with blunt proboscises and feather-like antennae. They measure about 0.3 to 0.7 mm. in length.

From various observations I was fully convinced that the hover-

[1] Kunhikannan, K., 'An Aggressive Mimic of the Red-Tree Ant', *Jour. Bom. Nat. Hist. Soc.*, xxxiv, pp. 373-374 (1915).

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ing of the flying insects over leaves of plants or in air was a sure indication of the presence of this spider sucking the juice from a red-ant in that locality.

Amyciaea forticeps, Cambr. generally dwell on small plants or weeds, that grow around any big tree where red-ants are in abundance, while *Myrmarchne platalcoides*, Camb., which mimic the same ants, generally weave their retreats on higher branches of plants. In the *Records* of the Indian Museum, Dr. K. Narayan writes:—'Dr. Annandale tells me that he has seen this (*M. platalcoides*) or a very similar spider eating specimens of this ant *Œcophylla smaragdina*).[1] But I have never seen a *M. platalcoides* touching a red-ant for food and it is rather possible that Dr. Annandale might have seen a member of *Amyciaea forticeps* who very much relish those ants.

These red-ants (*Œcophylla smaragdina*) build their nests on high branches of trees and plants and occasionally but not generally, they come down the trunk of the tree to the ground in search of food. In the Royal Botanical Gardens, Sibpore near Calcutta, I have often seen these red-ants coming down to the ground in columns; this is specially the case during the rainy season when the termites attack the decaying wood, leaves and bark of trees. They are very fond of these termites and are often seen loitering here and there along the mud-roofed lines of the 'white ants'. In weak places of the mud roofings they make a small hole with their powerful jaws and thrusting their heads in, catch the termites. Sometimes they lie in ambush by the side of a breach of the tunnel and intently watch the movements of the termites and snatch one of them when opportunity arises.

The mimicing spider makes good use of this opportunity to catch its victim, the red-ant, which has wandered from the file to get its prey, the termites. The spider waits its chance and attacks the ant as it halts apprehensive of danger and after a short tussle drags the victim to a suitable place. In the Botanical Gardens these spiders are mostly found loitering on the ground upon dead leaves and weeds. But in East Bengal these spiders are generally found on a kind of small plant where the red-ants are abundantly seen in company with a kind of plant-lice which attach themselves upon twigs and stems. Here my observations are slightly different from those of Major Hingston, who says:—'Amongst the leaves it makes a silk shelter from which it emerges to attack the ants'.[2] In numerous cases I have observed the spiders wandering about the lines of ants awaiting a chance to prey upon them without emerging from a neighbouring silk shelter.

In regard to the place of retreat of this particular mimicing spider, my observations are also different from those of Major

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[1] K. Narayan, 'Notes on Ant-like Spiders of the Family Attidae in the Collection of the Indian Museum', *Rec. Ind. Mus.* xi, p. 396 (1915).
[2] Hingston, Major R. W. G., 'Field Observations on Spider Mimics', *Proc. Zool. Soc. Lond.*, pt. ii, p. 846 (1927).

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Hingston.[1] The male and female of *A. forticeps* hardly shelter in any retreat except during the breeding time when the female makes an ingenious nest by folding a small leaf lengthwise and securing it by three stitches, one in the middle and two at the extreme edges. Inside the fold the female spins a round patch of white silk in which she lays about 15 to 25 yellowish globular eggs enclosing them once more in a white sheet of silk. (Fig. 2). The female spider sits upon the eggs and never goes out for about 15 days till the young ones are hatched. The young spiders do not leave their shelter for 5 to 6 days after hatching.

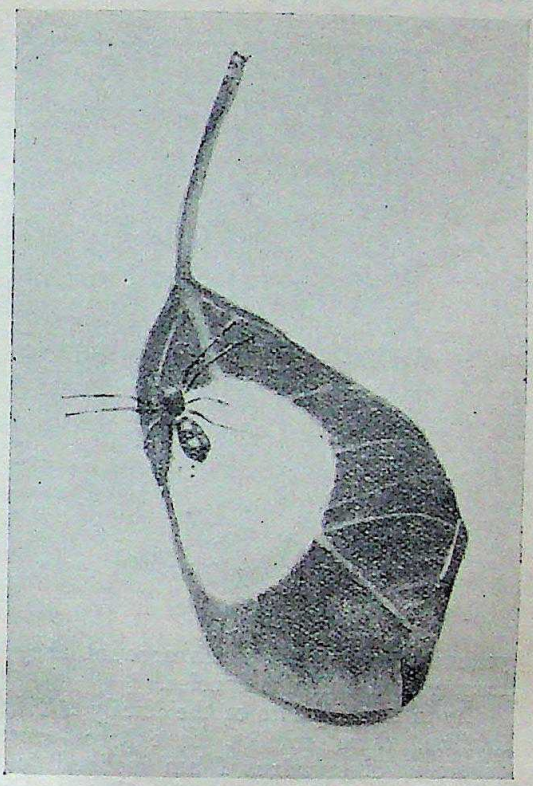

FIG. 2.—On the unfolded leaf, the female spider is seen sitting on her eggs.

The young spiders are quite different from their parents in colour, markings and other characteristics, as happens in most other classes of spiders. The colour of the mature spider is brick-red all over except the tarsal joints of the 1st. and 2nd. pairs of legs which are white. But these young spiders are light green all over with several prominent reddish-violet or crimson-red bands all over the first two pairs. Specially the femoral portions are thickly banded. The bands on the 3rd. and 4th. legs are less prominent. The two posterior abdominal spots gradually appear after 3 or 4 moultings.

During pregnancy, the female appears quite different from its normal condition. Naturally the abdomen is elongated with a wide dorsal depression in the middle, measuring about 1.2 mm. in width. But in pregnant condition, all the blackish shades and depressions disappear and the two black spots on the posterior portion of the abdomen become broader and more striking. The shape of the abdomen becomes somewhat triangular and truncated at its poste-

[1] Ibid., p. 846.

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rior end, rather than oblong; from one spot to the other the distance is about 3.5 mm. (Fig. 3.) The colour is now changed into a light

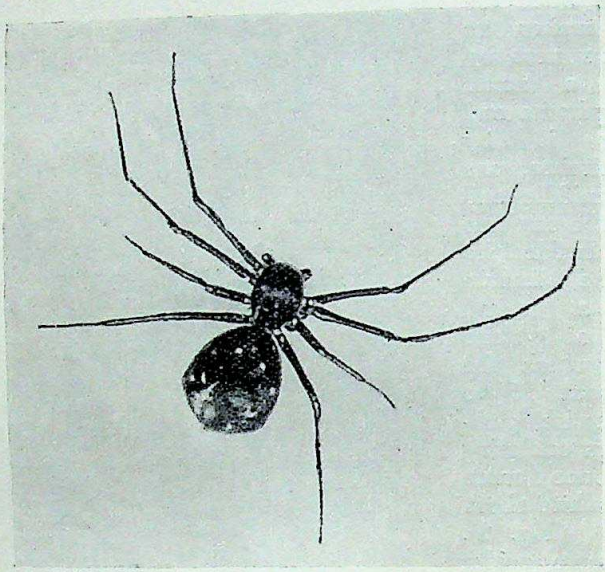

FIG. 3.—Enlarged photograph of *Amyciaea forticeps* (gravid female).

yellowish orange, on which account they may be mistaken as belonging to a different species.

As in most spiders of the family *Attidae*, and some of the other families, these mimics have two accommodating eyes. From numerous observations I am inclined to think that the power of vision, in several species of spiders of different families, such as *Thomisidae*, *Attidae* etc., is restricted to one pair of eyes only; the rest of the eyes may be of little or no use to them. In using the word 'accommodating' for this particular pair of eyes, it is meant that the spider can adjust the cones within the eyes for vision at different distances and at various angles. The anterior median pair of eyes of *A. forticeps* which are much smaller than the four lateral ones, are accommodating. They can adjust the inner retinal cones (or cone-like sacs) of these two accommodating eyes at will so as to have a clear and perfect vision. Mr. Mathew writes in a recently published article about the changing of colour of the eyes of a spider (*M. plataleoides*).[1] This phenomenon was also observed by Mr. T. Padmanabha Pillay, Trivandrum, and published in *Nature*, Vol. 68 (1908). I have, however, succeeded in observing different species of spiders having acquired these peculiar characteristics of moving their internal retinal cones of only one pair of frontal or median eyes. In some cases these accommodating eyes are bigger and in some cases smaller. In the case of *A. forticeps* it is the smaller pair of eyes.

[1] Mathew, A. P., 'A Spider that Changes the Colour of its Eyes at Will', *Jour. Bom. Nat. Hist. Soc.*, xxxv, No. 1, p. 132 (1931).

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Owing to the predatory habits they often lose most of their appendages and crawl with the help of pedipalps or remaining one

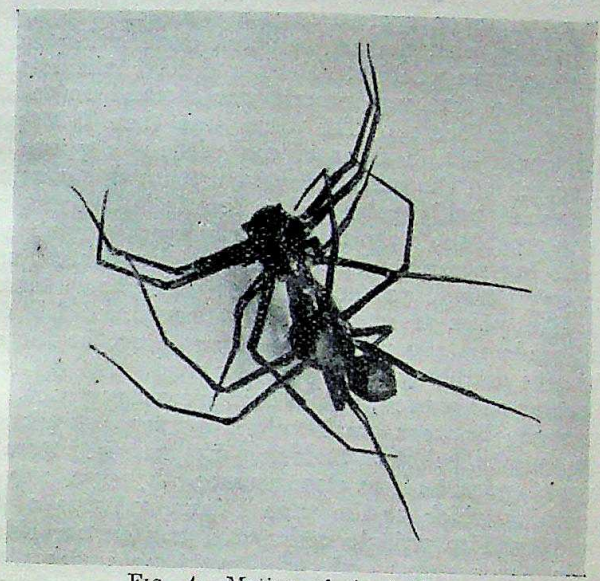

FIG. 4.—Mating of *A. forticeps*.

or two legs. Notwithstanding the timid habits of *A. forticeps*, the bigger *M. plataleoides* are no match for them and they are often defeated and become crippled in the short struggle.

The mating habits of these spiders are different from those of other mimics. Before mating both of them display their graceful movements of legs. The male comes upon her back from behind and rests his head in the same direction as that of the female. (Fig. 4). This position being unlike the ones observed in other spiders. A detailed account of mating of these spiders will be given in a subsequent paper.

GOPAL CHANDRA BHATTACHARYA.
93, UPPER CIRCULAR ROAD,
CALCUTTA.
September, 1932.

XXII.—A HUNTING WASP AND TRAP-DOOR SPIDER.

I was returning from my usual evening ramble watching birds, when my attention was drawn to one of the hornet-like insects alighting on the ground but a few yards away. If to know the Latin names of each and every bird and insect is essential before calling oneself a naturalist, then I do not come under that category, but can only be a lover of Nature. The wasp in question is not the mud wasp who makes mud nests in my library, stocked with green caterpillars, but a bigger species with a black metallic

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body, yellow legs and conspicuous brown sienna wings tipped with black which when closed she flutters at intervals the action reminding one rather of an agitated lady tapping herself with her fan. She landed on an open space alongside the cart track, her wings vividly contrasting with the ash coloured earth and at once began a search amongst the pebbles. Back and forth she hunted much like a gun dog so that my interest was aroused as to what was the object of her search. The time was then 5-55 p.m. She crossed the track just in front of me without a pause and continued her search on the other side where there was a small cactus alongside a small toddy palm and a few isolated tufts of coarse grass. At intervals the wasp momentarily paused, gave a few agitated flaps to her wings, and then resumed her search, sometimes forcing her way through patches of grass which must have towered above her like palm trees. The hunt continued till 6-10. By then I had made up my mind that it could not be for any class of mud she was searching it must be for food. At last, quite near the small cactus she paused, not 18 inches from my boot. It was a little open space between small tufts of grass and alongside one small white quartz pebble. Suddenly she savagely tore at some small scraps of grass, as if to clear a space, then suddenly appeared to lift something which at the time I imagined was a small clod of earth and tried to wriggle under it, lying on her side. Twice she failed in her attempt and came out from under what I still thought to be a clod of earth and stood as if contemplating. I now thought I was watching the wasp starting to make a new nest, though it seemed very late in the evening to start on such a big task. Again the struggle with the clod of earth commenced, and now I was on my knees, and realized I was witnessing a case of day-light house-breaking, and that the object of attack was not a clod of earth, but the flap door of a trap door spider's nest. Now I was nearer and with the aid of my eye-glass I was able to better realize what was happening. The wasp struggled to lift the trap door and again got on her side, at intervals thrusting in her sting beneath the lid. Suddenly she disappeared under the trap door of which presumably the spider had relinquished her grip and retreated down the tunnel. The spider must have fought her ground inch by inch and sometimes proving the stronger, for occasionally the trap door fluttered, showing the wasp had been forced to retreat. It was now 6-25 and past sun-set.

Curiously it was only the previous day that I had been reading Alexander de Mattos' translation of Fabre's *Life of the Spider* and the fights between the bee and the Tarantula. But here I realized was an entirely different case going on right below my feet, for had not I watched the wasp for half an hour searching for the trapdoor, like a dog hunting for truffles. And so the wasp's attack must have been deliberate, planned with malice and aforethought, an incident of her daily life of house-breaking and murder. Ten more minutes passed and no sign of anything on the surface, and now as dusk had come I got a screw driver and an electric torch from the car, for I couldn't go home without knowing who had won the fight. Carefully I lifted the trap whose edges were only

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just visible with the aid of my eye-glass held to get the greatest magnification, and poked a piece of grass down the hole. At less than 4 inches I met an obstruction and a moment after the wasp appeared, very agitated, flapping her wings, and at first stood alongside the trap door. Having been stung once by one of these infuriated ladies I rose from my knees. I rather hoped the wasp intended to renew the attack, but after most carefully dusting herself and walking up and down as if to sum up the pros and cons of the situation, she flew away. I waited a few minutes with the hope that the spider would regain hold of the flap of the door, then lunged the screw driver into the earth at an angle, as advised by Fabre, but only succeeded in extracting the top section of the trap door spider's nest, luckily with trap intact which is on the table before me as I write.

The measurement of the sloping tunnel is just $\frac{1}{2}$" in diameter. This I imagine would have made the fight fairer, for I do not think the wasp which is at least $1\frac{1}{4}$ in. long could have brought her sting into play in such a confined space. So during that quarter of an hour those two ladies had been fighting cheek to jowl like a dog and a badger.

This is the first time I knew trap door spiders lived in India. E. H. A. does not mention them. I have studied them in the Murchison district in West Australia, and there their main enemy is a lizard, which burrows down incline shafts to attack the colony. To circumvent this, the spiders build a ring of dummy holes at a small distance around the inhabited colony, to delude the lizard, and make him waste his time in abortive mining.

If all trap door spider's nests in India are like the one before me, I defy anybody without microscopic examination of each inch of ground to find them. The trap now, even after the camouflaging grass has been removed by the wasp, and the edge of the trap slightly bent by the screw driver, is quite indistinguishable to the naked eye from the surrounding earth. To follow up my search it seems the only thing to do, is to watch the movements of the brown sienna winged wasp, who may have discovered the nest by smell. But it is unwise to jump to hasty conclusions when studying insect life.

LINGSUGUR,
RAICHUR.
September 12, 1933.

L. MUNN,
Capt.

[The Wasp to which Capt. Munn refers is a Pompilid species known as *Salius flavus*. It is a common yellow insect with yellow wings which are deep purplish black at the apex. It nests in the ground, and its usual prey is spiders. The huntress lays her eggs in the Spider's body after rendering it comatose with its sting. For this purpose it is usually seen busily searching the ground for spiders with great patience. It moves quickly on its long limbs and its occasional flight is very graceful to look upon. Combats between spiders and this wasp are frequent. The spider usually emerges from its hole and stands at bay with erect cephalothorax

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and jaws (with the poison fangs) wide open. Its action is entirely defensive. There is a series of tactical movements displayed by the Wasp. It seems to realise the capacity of the death dealing jaws of its antagonist. She approaches with the greatest caution, turns round and round, the spider doing the same, always facing its attacker. The wasp however appears to know the weak point of the spider, namely its inability to strike upwards. She therefore seeks an opportunity to jump on the spider and with a clever and agile leap, alights on its back. It applies its sting, first paralising its victim's poisonous weapons from below. It stings again thrusting its lancet along the side of the cephalothoracic shield which covers the head and chest of the spider. The victim is thus paralised and the fight ends. *Salius flavus* is never found frequenting houses as it almost exclusively confines itself to catching ground spiders.

Dr. Gravely has written a popular article on Indian Spiders in the *Journal* of the Society, vol. xxviii, p. 1045, in which he refers to the Trap-door Spiders.—Eds.]

XXIII.—A MEANDER THROUGH THE CINCHONA PLANTATION.

One bright and clear day during a break in the monsoon, we motored to the western area of the Cinchona Plantation. Our way led us through the Ipecacuanha nurseries where men were trimming and planting rooted cuttings, each in its own little place, in long even rows. Ipecacuanha is a small evergreen plant from the roots of which Emetine is extracted. It is of great medicinal value, especially in the treatment of Dysentery.

The pathways, which in the dry weather are baked hard, were covered with tiny ferns and grasses, and around us on the hillsides arose tall forest trees, and those near the stream on swampy ground, were covered from root to top with Screw Pine, the adventitious roots of which were securely fastened to the tree, giving the tree, at a distance, the appearance of being covered with strips of green ribbon.

We continued our way through the virgin forest keeping a good lookout for snakes, which have a habit of basking in the sunlight, or on the warm grass almost unseen. My husband had a bad shock sometime ago. He trod on what appeared to be dried rubbish, but which concealed a Cobra, and in a flash an arc of fury appeared. With the instinct of self preservation which dwells in all living creatures, my husband saved his life by lowering a large Chinese umbrella which he was carrying, and which caught the vicious stabs, before the reptile vanished down the hillside.

The forest was rich in vegetation which is never seen in the dry weather. Creepers of all shapes and sizes were climbing the trees, joyous and green, all in a hurry to reach the top of the tree and sunlight.

Clumps of bird's-nest ferns, orchids, which later will give yellow, white, mauve, and pink flowers, and many other epiphytes and ferns, covered the branches and treetops.

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The huge buttresses and boles of large trees were turned into fairy gardens, and were covered with mosses, lichens, tiny ferns, and dainty Begonias with heart-shaped leaves and pink wax like flowers. Occasionally a tiny stray Begonia would be in flower quite fifteen feet up a tree.

From the rank undergrowth many flowers pushed their heads. Here a splash of red Ixora, a white Polygonom with dainty spike-like sprays of flowers, reminding one of the Lily of the Valley, a creeper with hard purple balls of flowers lying close to the stem, and on the ground a plant with variegated leaves and flowers both mauve and violet, it has no perfume but we call it the violet.

We emerged into the bright sunlight and the Cinchona Plantation. The wonderful febrifugal quality of the bark is well known, but it is a very delicate plant to grow and needs much care and attention.

The trees were in flower and the air was filled with a perfume like new mown hay. Under our feet the path was covered with springy grass among which grew tiny Oxalis and Vandelias. The dew still glistened on the grass and where it lay upon a cobweb, the cobweb was transformed into a shining gem of exquisite workmanship.

In the crevices and crannies of the banks were Selaginella, mosses, lichens, and fungi. We found one lovely specimen of Lycopodium climbing a tree, it was quite a yard and half in length. There were fresh depressions in the soft ground of a Bison's feet, for the jungle folk still wander in their old haunts.

Around us was Cinchona of a hybrid type, and as the leaves seldom come true to either of their parents they were of a great variety. Some had shiny dark green lanceolate leaves, others were much larger and broader, twice the size of the first, of a lighter green, traversed with brilliant crimson veins and stalks of the same colour. Between the two, leaves of many shapes and sizes.

The flowers were both pink and white. Large panicles of tiny flowers some of which had gone to seed. The seed pod is cylindrical, about half an inch long, containing numerous tiny light seeds, many thousands of which go to make an ounce.

In Bengal, Cinchona is grown at an elevation of between 2,000 ft. and 5,000 ft. Here it is grown between 200 ft. and 1,000 ft. and climatic conditions are very different. Shade trees are necessary during the heat of the dry weather, so with a view to shade, manure, and when the Cinchona is uprooted, to reafforestation, several varieties of forest trees are planted. *Gliricidia maculata*, which in the spring is a mass of sprays of pinky mauve blossoms springing from its bare branches, *Erythrina indica*, *Grevillia robusta*, *Pyinkado*, the Ironwood of Burma, Rubber, Cassia with yellow scented sprays of flowers. All are intermingled with Cinchona and make one large garden, through which several miles of road and path meander.

Quite near we heard the tap-tap-tap, of wood upon wood, and the murmur of children's voices, we are near the object of our walk. There in the shade of the trees sat the children each upon a sack, with a quantity of small washed broken branches beside each. In front a long basket lying on its side, with its opening

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towards the child. The piece of Cinchona to be barked is placed upon a small block of wood and the bark knocked off with a small wooden mallet, and scraped with a blunt knife into the basket.

We continued our way uphill, butterflies darted around, the air was filled with the cheerful buzz of insects, all nature rejoiced at the sunshine after so much rain. A breeze swayed the graceful branches of the Gliricidia and made the Silver Oak leaves dance.

At last we were at the top of the hill, and what a view met our eyes! Although only about 600 ft. up we appeared to be on the edge of a gigantic green basin, with a dip towards the west. All around us were range upon range of evergreen forest. Looking before us in the distance, dark green of virgin forest, on a ridge in the middle distance the Doctor's house and hospital, among the bright green of the *Phaledo*, our house on the next ridge among the darker green of the rubber, a patch of bamboo jungle, then a strip of dark forest descending to the valley. To our left at the very bottom of the basin were the workshops, houses, bazaar and a large tin mining dredge all looking like tiny toys in the bottom of the enormous green bowl.

We turned our steps homewards, and were glad to dip once again into the forest, away from the sun. In the cool shade the small tree stumps were covered and made beautiful with a tiny climbing *Ficus*. A *Cycas revoluta* stood among the jungle. One of the oldest known plants, found in fossils all over the world, yet growing in its natural state here. We found a cluster of double seed-pods ,two pods joined together formed miniature Ram's Horns. Then a small black tree stump with a filigree of dainty lace in pure white lichen.

A sound in the jungle! and the calling of monkeys not far away, and away dashes the dog, regardless of our calls, forgetful that only last week he and his mate dashed into the jungle, then a snarl! A yelp! and only he returned very frightened and subdued. A hunt yielded the remains of his poor little pal. She must have rushed straight into the leopard.

At last we were among the coolie houses which are built of the ever useful bamboo, and roofted with dhani palm, lifted about 4 ft. above ground on posts, and each having some cultivation, chief of which is the *Manihot utilissma*, with digitate leaves on long red stalks. The root gives a kind of yam, is used as a vegetable and has a slightly bitter taste. It is ground into flour for bread, and is often fermented and made into a drink much appreciated by the coolies. Many chubby children, some quite naked, played in the sunshine, among the dogs, goats, and hens.

We climbed again through the rubber to our house and the perfume from the Frangipani welcomed us home.

GOVERNMENT CINCHONA PLANTATION,
MERGUI, LOWER BURMA.
September 21, 1933.

MRS. P. T. RUSSELL.

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Continued from Vol. XXXVI, No. 4, of the Journal of the Bombay Natural History Society.

THE WILD ANIMALS OF THE INDIAN EMPIRE

AND THE

Problem of their Preservation

Part II.

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Photo by *F. W. Bond.*

The Himalayan Thar (*Hemitragus jemlaicus* H. Smith).

(*Height at shoulder 36-40 in*).

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THE HIMALAYAN TAHR (*HEMITRAGUS JEMLAHICUS*. H. SM.).

The Tahr does not compare well with his big-horned relatives the Ibex and Markhor. It is a wild goat with a finely formed head, narrow erect ears, a heavy body and long robust limbs. A well grown male stands from 36-40 in. at the shoulder and scales near 200 lbs. While the hair on the Tahr's head and face is short its body is covered with tangled masses of coarse, flowing hair. It grows longest on the neck and shoulders where it develops into a mane which sweeps down to the knees. An old buck poised on some precipitous cliff presents a grand picture. The colouring is very variable. Generally it is a deep reddish brown and there is a dark dorsal streak—not always distinct. Old males are darker, particularly about the back and quarters. Ewes and young males are lighter brown; kids much paler.

The horns are short and close set. They are stout at the base, keeled in front and wrinkled, except towards the tips. They curve backwards and in old bucks continue downwards. They are about 15 in. in length with a circumference of 10-11 in. at the base. The record measures 16½ with a girth of 10½. Females are smaller in build. Their horns are dimunitive. They are easily recognised by their lighter colouring and less shaggy coats.

Tahr live in a precipitous terrain of towering cliffs, rock and forest. Because of the difficult country they inhabit, it is said that few Himalayan game animals so tax the skill and endurance of the hunter.

About March and April before the snows have melted, Tahr crowd into the bottoms of the valleys. In summer, the older males herd together or live singly. They frequent the densest undergrowth and the most precipitous cliffs. They rejoin the females in late September or October. During the rutting season the males are always fighting and many are said to be killed by falling down the crags.

Tahr feed in grassy spots among rocks. If alarmed they go off with great speed and clatter but soon halt and turn to stare at the intruder. They generally follow the guidance of an old male and seek security in the almost perpendicular precipices. Their sense of sight and smell are both keenly developed. The range of the Tahr includes the Himalayas from Kashmir to Bhutan but does not extend to the northern side of the Vale of Kashmir. Tahr are common on the southern slopes of the Himalayas but do not occur on the Tibetan side of the range.

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THE NILGIRI TAHR (*HEMITRAGUS HYLOCRIUS* BLYTH).

Frequently misnamed the Nilgiri Ibex, the Nilgiri Tahr is a near relative of the Himalayan species. It is slightly larger than the Himalayan Tahr, standing 39-42 in. at the shoulder. Its short crisp coat, the rounded outer surface of its horns and the presence of only a single pair of teats are other distinguishing characters.

The general colour of the animal is a dark yellowish brown, paler on the undersurface. Does and young bucks are grey. With age the bucks get a very deep brown—almost black coat with a distinctive light 'saddle' patch on the loins. From a distance the saddle looks almost white. In build bucks are far heavier and sotckier than the does.

The horns, almost in contact at the base, rise parallel for some length then diverge and curve downwards in a bold sweep. They are deeply wrinkled. The knotted keel in front, so distinctive in the horns of the Himalayan Tahr, is absent. The record buck horns measure 17½ with a girth of 9⅞ in. The record doe 14 in. Nilgiri heads are small in comparison to those found in the more southerly ranges.

Nilgiri Tahr live on the open cliffs and when alarmed take shelter on the precipitous slopes. They feed in flocks on the grassy downs which top the summits, grazing in the early morning or late afternoon and resting during the hot hours of the day. One or more does stand sentinel over the resting herd. While exceedingly watchful against any danger approaching from below, they are frequently outwitted by the enemy from above. Panthers levy the heaviest toll on the herds.

During the south-west monsoon Tahr generally move down to lower elevations. Old bucks desert the herds during the hot weather and, more often than not, are found solitary. Tahr sometimes have two young but one is more usual. The kids are dropped most commonly during the hot weather.

The isolated distribution of this wild goat so far south of the usual range is interesting and is taken to indicate the existence at some remote epoch of the earth's history of conditions which enabled Tahr to inhabit the country now lying between the Himalayas and the Nilgiris.

Strict preservation has saved the Tahr from extermination in the Nilgiris. From these hills its range extends to the Anamallais and thence southwards along the Western Ghats.

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Photo by *Salem A. Ali.*

The Nilgiri Thar (*Hemitragus hylocrius* Blyth).
(*Height at shoulder 39-42 in.*).

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Sub-Family III. *Rupicaprinae*: Goat-Antelopes.

Serow, Goral and Takin.

The Goat-Antelopes are said to hold an intermediate position between the Goats and that heterogeneous assemblage of animals collectively known as 'Antelopes'. All of them are mountain animals. Most have a more or less goat-like build, goat-like teeth and short tails. Relatively small cylindrical horns are present in both sexes.

Serow, Goral and Takin belong to this group. It also includes the Chamois (*Rupicapra*), the type which gives its name to the group, and the Rocky Mountain Goat of North America.

Serow and Goral have distinctive conical horns. They curve backwards and have not the terminal hook seen in the straight horns of the Chamois. Though there is a superficial resemblance between them, Serow and Goral differ much in the structure of the skull. Further, unlike Goral, Serow have well-developed face glands which rest in a depression in the skull. The gland opens with its small orifice in front of the eye. At times the opening looks like a small sore. It exudes a whitish secretion which, when dry, has the consistency and smell of gum arabic. Serow have a strong goaty odour. As in sheep and goats it appears to come from the surface of the skin and not from any special glands.

Goral are much smaller animals than Serow. They have no face glands but are furnished with foot glands similar to those found in sheep. These glands open by a small orifice in front of the pastern, above the hoof. It is not known whether Serow have them. Strangely enough, in the structure of its skull, the Goral approaches the Takin. A kinship is here suggested which one would not easily suspect from the widely different appearance of these two animals.

The Takin is a large heavily built, aberrant form of goat-antelope. It lacks that lightness of limb and body to which Serow and Goral owe their agility. The horns, which are thick and nearly in contact at the base, grow outwards, downwards or forwards and then take an abrupt curve upwards or backwards in the same direction as the plane of the face.

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THE SEROW (*CAPRICORNIS SUMATRAENSIS* POCOCK).

With its large head and donkey-like ears, its thick neck and short limbs the Serow is an ungainly creature. Its habit of standing with its forelegs astraddle, the hoofs widely splayed and the head thrust downwards adds to its awkward appearance. Both sexes are similar in build. A full grown Serow is from 36-38 in. at the shoulder and scales from 170-200 lbs.

The coat is coarse and rather thin in Serow which live at lower elevations. Its colour varies so much that it is difficult to describe. It ranges from grizzled black or blackish grey-roan to red. In the darker animals the head, neck and the mane, which covers the nape and withers, is grizzled black. The black passes into rusty red on the shoulders, flanks and lower thighs and turns a dirty grey on the inside of the limbs and belly. There is a varying amount of white on the muzzle, throat and chest. In the Chin Hills and Arakan a red race of Serow (*C. s. rubidus*) occurs. In the Himalayan races the limbs are chestnut above and dirty white below from this there is a transition to the Malay serows in which the limbs are wholly black.

Horns are common to both sexes. They are black, conical and closely wrinkled for three quarters of their length. They run to 10 or 11 in.

In the Himalayas the Serow favours an elevation between 6,000 to 10,000 ft. In the Burmese hill ranges they may be met with at a height which varies from 700 to 8,000 ft.

Serow live in the recesses of thickly wooded gorges whose boulder strewn slopes and shallow caves give them shelter from the weather. In the mornings and evenings they come out to feed on the rank herbage of the more open slopes. They are more or less solitary creatures though four or five may be seen feeding on the same hill. Their movements belie their awkward appearance. They are exceedingly active animals, not only on rock but also on flat ground. When disturbed, serow dash away with a hissing snort. Their call is a whistling scream. The female usually has one kid at birth, sometmies two. In the Himalayas the rut commences at the end of October and the young are born in May and June. In Burma the young are born about the end of September. The period of gestation is said to be about 7 months.

Serow range from the Himalayas to the mountains of China and southwards through Burma and the Malay countries. They are also found in Formosa and Japan. Eight races have been described from British India and the Strait Settlements all localised forms of a single variable species.

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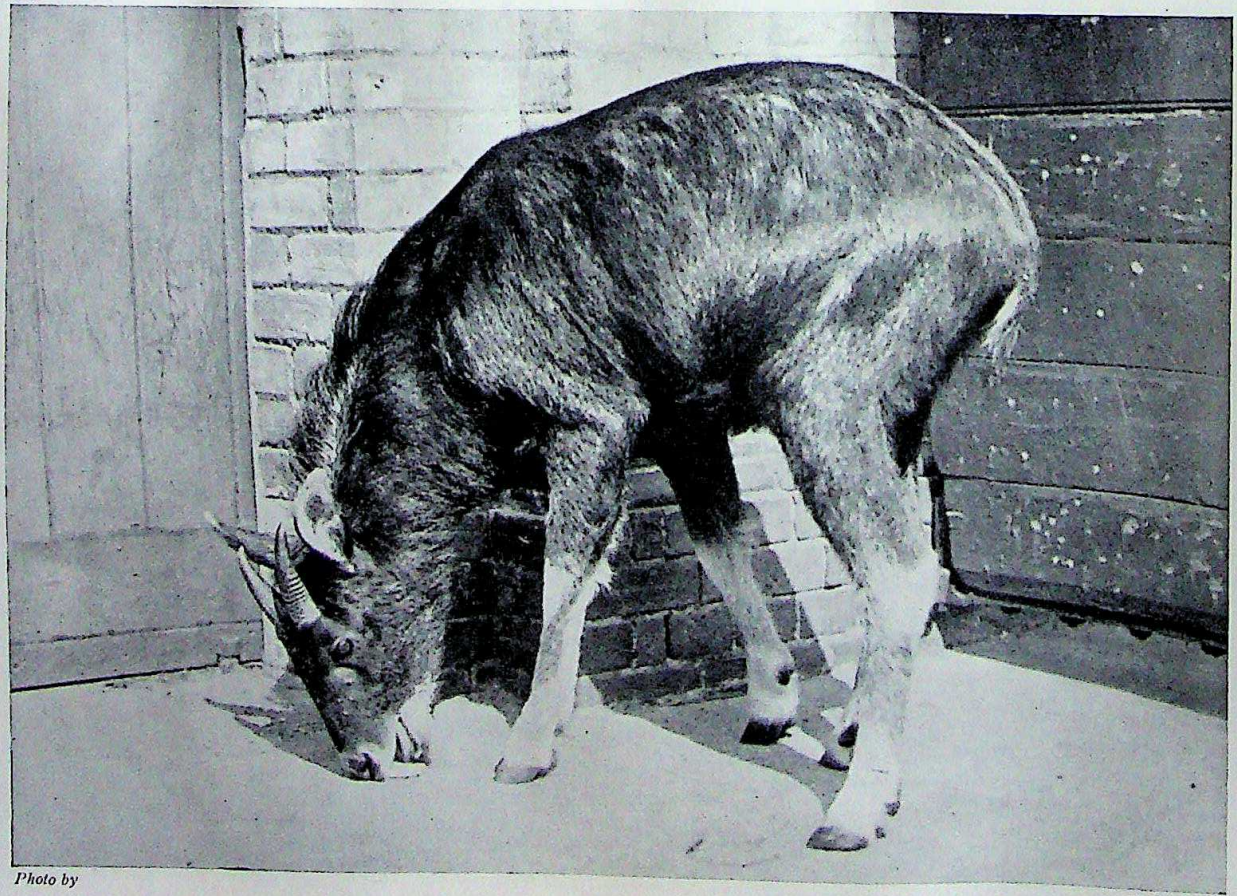

Photo by *F. W. Bond.*

Şerow or Goat-Antelope (*Capricornis sumatraensis* Pocock).
(*Height at shoulder 36-38 in.*).

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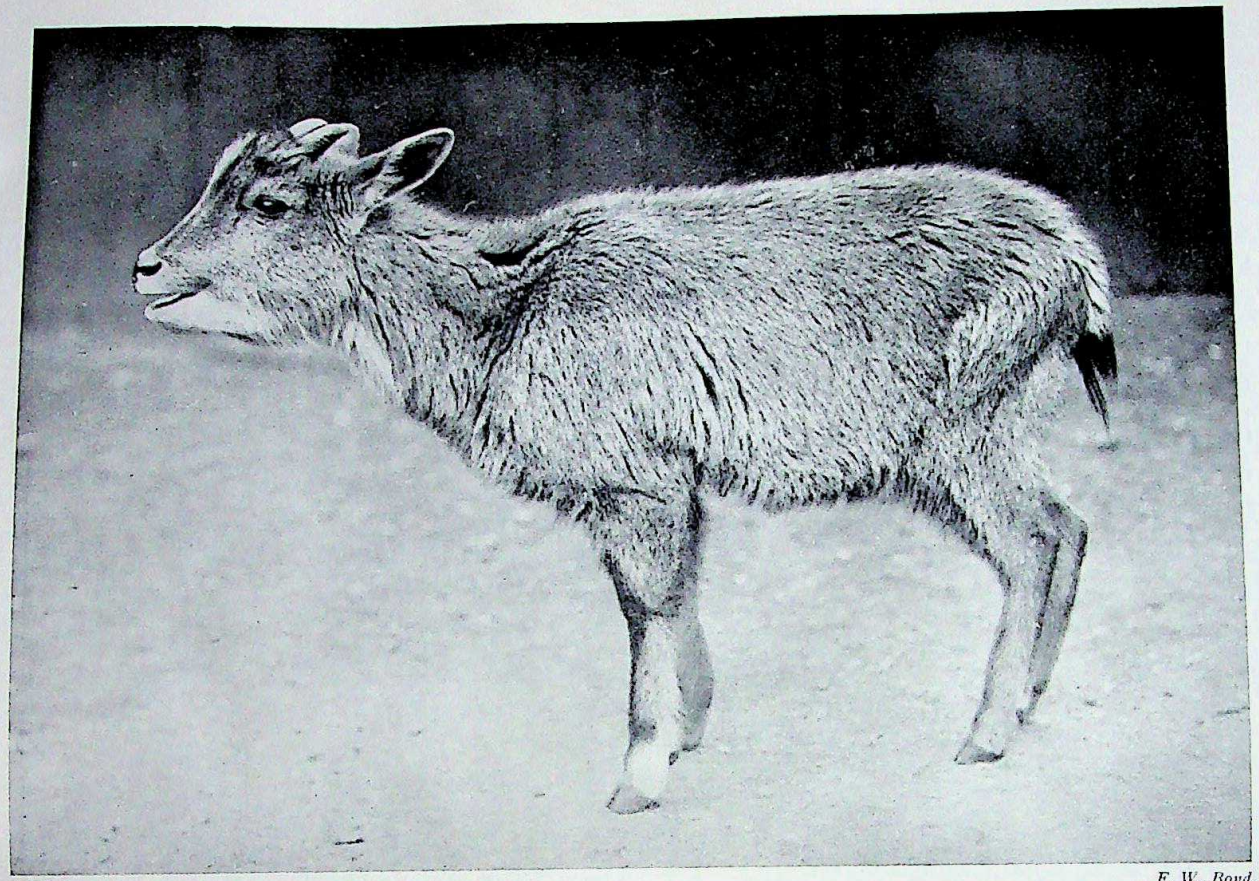

Photo by *F. W. Bond.*

A young Goral (*Nemorhaedus goral* Hardw.).

(*Height at shoulder 26-28 in.*).

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GORAL (*NEMORHAEDUS*).

Three species of Goral are found within the Indian Empire:—The Grey Himalayan Goral (*Nemorhaedus goral* Hardwicke) of Kashmir and the Western Himalayas, the Brown Goral (*N. hodgsoni* Pocock) of Nepal and Sikhim, and the Burmese Goral (*N. griseus* Milne-Edwards) found in Burma, Eastern Tibet and Southern China.

The Goral is sometimes called the Himalayan Chamois. It has little in common with the Chamois and is distinct in the form of its horns, and the colouring and shagginess of its coat. Its kinship with the Takin has already been suggested. The Goral is a goat-like animal standing about 26-28 in. at the shoulder.

The general colour of the Grey Goral is a yellowish grey suffused with black. Individuals differ, but no Grey Goral has the pale area of the hairs tinged with rufous or brown. The chin, upper lip, underside of the jaws and throat patch are white. The dark spinal stripe if present, does not pass beyond the withers. There is no stripe down the middle of the tail and none up the back of the thighs. The Brown Goral is distinguished by its golden or rufous brown coat, speckled with black. The black spinal stripe reaches to the root of the tail but tapers away and is indistinct on the croup. The tail is black above. A dark ill-defined stripe runs up the back of the thigh from the hocks.

The Goral of Burma is distinguishable from the two Himalayan forms by two main characters. The tail is larger; about 5 ins. long in the adult. The black stripe on the fore-leg does not pass over the knee as in the Himalayan Gorals but turns aside and runs down the outer side of the cannon bone on to the back of the fetlock.

Goral have short insignificant horns. They diverge slightly, curve backwards and are marked with rings or ridges for the greater part of their length. The record pair of Grey Goral horns measures $8\frac{7}{8}$ in.

Goral frequent hillsides or rocky forest clad ground. They graze in small parties of 4-8 individuals. Old bucks are frequently solitary. In the Himalayas, Goral favour an elevation of 3,000-9,000 ft. though they may ascend to and have been observed at 13,000-14,000 ft. In the Arakan and Chin Hills, Goral are found above 3,000 ft. In Garhwal new born young have been observed in April.

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TAKIN (*BUDORCAS TAXICOLOR* HODGS.).

There are said to be three species of Takin:—The Mishmi Takin (*Budorcas taxicolor* Hodgs.), the Tibetan Takin (*B. tibetana* M.-Eds.) and Bedford's Takin (*B. bedfordi* Thomas). So far as is known the Mishmi Takin occurs in Bhutan Himalaya in the Mishmi Hills, on the Burma Assam Tibet frontier and in the Mountains of the Salween Irrawady divide. The Tibetan Takin is found in Eastern Tibet and Western Sze Chuan. Bedford's Takin in the Tsinling Range in Shensi, W. China. It is possible that the three forms are geographical races of a single species.

The Bhutan Takin is recognised as a separate race, *B. t. whitei*, because of its smaller size, darker colouring and smaller saddle.

The Takin is a clumsy heavy animal which from the shape of its horns looks as if it might have some relation to the gnu or musk ox, though there is no structural affinity between them. Its most striking feature is its immense convex 'face', heavy mouth and tremendously thick neck. The muzzle, except for a bare spot at the extremity is covered with hair. It is a character seen also in the yak and is probably associated with life at high altitudes, where the snow in winter has to be scraped away to get at the vegetation beneath. The Takin's heavy body is supported by exceptionally short, thick legs, thicker than those of a bison. Its withers are slightly raised and its narrow back arches in the centre and slopes downward to the root of the tail.

There is great variety of colour in Takin, ranging from dark brown to golden yellow. The withers are conspicuously lighter in tone. Adult males of the Mishmi Takin are golden yellow merging into dark brown or black on the flanks and quarters. There is a dark dorsal stripe. Young males are reddish brown in front merging into black. Calves all black. Females are greyer than the bulls with no trace of yellow. The dark dorsal stripe is inconspicuous in females and young males.

The horns of a young Takin grow straight up from the head with an outward tendency. Later they grow outwards and downwards. In the final stage the horns grow forwards, bend downwards and outwards with the points growing up.

Takin live in the steepest and most thickly wooded declivities of their native mountains. In the Mishmi hills they have been seen in tropical forest as low as 3,000-4,000 ft. They are usually found in dense bamboo and rhododendron jungle at an elevation of 7,000-10,000 ft. In the summer months they collect in herds of considerable size as many as 300 have been observed congregated about a hot spring to drink. They went to cover at mid-day and came out in the late afternoon. In the winter the herds are said to break up into smaller parties. In Western China the rut takes place in July, August. The calves, usually one at birth are dropped towards the end of March or early in April.

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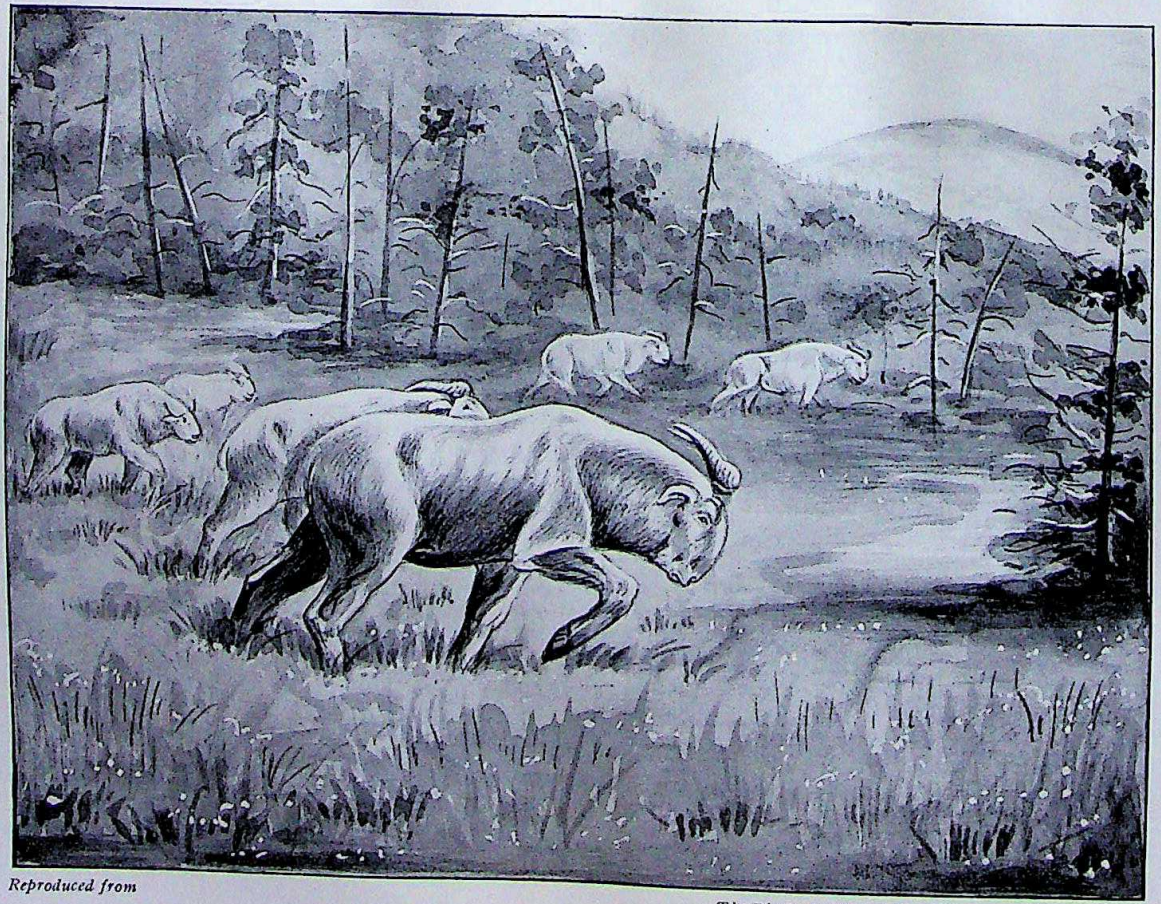

Reproduced from *The Big Game of Central and Western China—Wallace.*

Takin (*Budorcas taxicolor* Hodgson) changing ground.

(*Height at shoulder: bull 51, cow 42 in.*).

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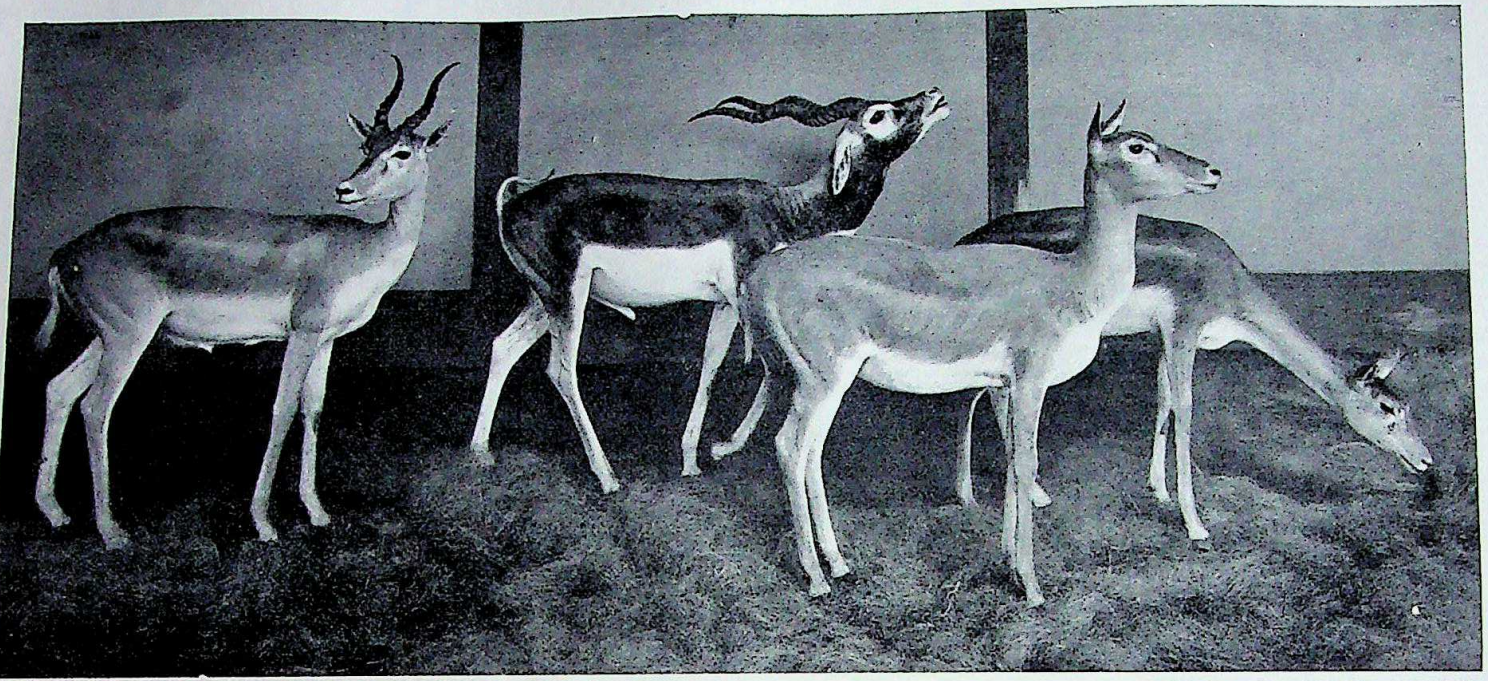

By courtesy of *The Amer. Mus. Nat. Hist., New York.*

The Black Buck (*Antilope cervicapra*, L.).

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Sub-family IV. *Antilopinae*: Antelopes.

The Antelopes form an extensive group of ruminating ungulates which includes almost all the remaining members of the Bovine family. Although the term 'antelope' is in common use and though most antelopes are easily recognised, they are so numerous, so diverse in form that it is difficult to distinguish them as a whole from the oxen on the one hand and the goats on the other. They represent a transition between the two. Antelopes are the most generalised and oldest known representatives of the *Bovidae*. It is believed that the more distinctive and more specialised members of the family which we have so far described have been derived from them. In general, antelopes are light and graceful in build. Fleet of foot, they depend for their safety on great speed. Horns may or may not be present in both sexes. The bony core of an antelope's horn is nearly solid throughout and not honeycombed as are the horns of oxen. In the structure of their teeth some Antelopes resemble oxen, others, the sheep and goats.

Antelopes very generally have a gland beneath the eye, which distinguishes them from oxen and goats. The prominent glands below the eyes of the Indian Antelope or Black Buck attract the attention of most people. When closed the gland takes the form of a vertical slit of black, nearly hairless skin. This opens into a deep hair lined and perforated pocket into which the secretion of the underlying gland exudes.

It is difficult to surmise the exact function of these glands. They are present, as we have already seen, in other ruminants. They may have a sexual significance. They are particularly active in certain seasons and generally better developed in males than in females. But apart from this they may also serve as scent glands and, like the foot and other skin glands serve as a guide in keeping individuals of a herd together.

Antelopes are not nearly so well represented in India and Malaya as they are in Africa. If we exclude the widely spread group of gazelles the only Antelopes found outside Africa, Syria or Arabia are the Black Buck which is confined to India, the Saiga Antelope of Tartary and the Chiru of Tibet.

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THE CHIRU OR TIBETAN ANTELOPE (*PANTHALOPS HODGSONI* ABEL.).

In the elevated and barren plateaux of Tibet there is a species of antelope which is remarkable for its curiously swollen snout and long, elegant horns. This is the Chiru, an antelope which is said to be the living prototype of the fabulous unicorn. Its long and slender horns, if seen in profile, may well suggest a unicorned animal. The Chiru is classed in a separate subfamily of antelopes —the *Panthalopinae* of which it is the only representative. The nearest relatives of the Chiru are the Saiga Antelope of Eastern Russia and the Impala of Africa. The Saiga carries to greater degree the curious snout development of Chiru. Its nose is inflated and prolonged into a downwardly bent, trunk-like proboscis. This inflation of the nose may have some connection with the high altitudes in which these animals live. At the side of each nostril, the Chiru has a large lateral chamber or sac whose function may assist breathing in the rarefied atmosphere of its native wilds.

Another peculiarity of the Chiru is the unusual development of the inguinal or groin glands. Perhaps the function of these glands, which are possessed also by other ruminants, is to scent the ground and so indicate to other individuals of a herd the place where one of them has rested. Chiru are known to lie up concealed in shallow pits which they scrape out for themselves in the sand. Large scent glands are also present between the fore and hind hoofs of the Chiru. It has no face glands.

The Chiru stands about 31-32 in. at the shoulder. Its body is covered with dense wool. The colour is variable. Generally it is pale fawn above and white below. The whole of the face and a stripe down the front of each leg is black or dark brown in the bucks. The horns of the bucks rise close together; they diverge towards the tips and curve slightly forward. They reach from 24-26 in. The record pair is $27\frac{3}{4}$ in. Females are hornless.

Chiru live in the open rolling plains and the broad river valleys of the Tibetan Plateau, some 12,000-18,000 ft. above sea level. They may collect in large herds but it is more usual to find them in small parties of 3 or 4. They graze on the grass and small plants which grow on the open wind swept river flats. In summer the bucks live apart. The young are born in May and June. One young is produced at birth.

The Chiru is found only on the Tibetan Plateau. Its range extends north from the Chang-chenmo district of Ladak along the Nepal Tibetan frontier to the north of Tibet.

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The Black Buck (*Antilope cervicapra*, L.).
(*Height at shoulder about 32 in.*).

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THE BLACK BUCK OR INDIAN ANTELOPE (*ANTILOPE CERVICAPRA* LINN.).

The Black Buck is the sole representative of the genus *Antilope.*

Its striking colour; its beautiful spiraled horns, which may reach the shoulder height of the animal, give it an elegance hardly equalled by any antelope. This exclusively Indian animal is perhaps the most beautiful of all its tribe.

A well-grown buck stands about 30 in. at the shoulder and on the average weighs some 80 lbs. When young, its coat, like that of the does, is a yellowish fawn. When 3 years old it commences to turn black. This darkening of the coat varies in intensity. In South India the adult buck is rarely black, his coat remains a dark brown. Well matured brown bucks may again be seen in all parts of the country. In general there is a fading in the richness of tone during the hot weather and an increase in its velvety lustre after the rains.

In the yearling buck the horns are without a spiral. In the second year a large open spiral is developed. It is believed that the full number of spiral twists are attained with the dark coat about the end of the third year. The best heads come from the dry and arid districts of the Punjab and Rajputana, the poorest from South India and the humid plains lying west of the United Provinces. Here a head above 18 in. is considered good. The record 31⅞ in. is from Jind State.

Black Buck are usually seen in herds of 20 or 30, though in Rajputana and the Punjab herds may number several hundreds. Black Buck live in open plains covered with scrub or cultivation. They feed on grass or various cereal crops. Usually Black Buck graze till mid-day and again in the late afternoon. Their sense of hearing is moderate: scent fair. Keen eye-sight and speed are their protection. When alarmed the herd moves off in a series of astonishing leaps and bounds and then breaks into a gallop. The leadership of the herd is usually vested in an old and vigilant female. There is generally an old buck in attendance who keeps in the vicinity. He frequently deserts the herd for a period taking a favoured doe with him. Black Buck breed at all seasons but mainly about February and March. Then the bucks grunt and strut about with their peculiar gait, their heads thrown well back. Their great face glands are everted and give off their strong smelling secretion. One or two fawns are born at a time, these are usually concealed by the mother in tall grass or among bushes.

Black Buck may be found practically all over the Indian plains except on the Malabar Coast. They avoid forest or hill tracts.

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THE CHINKARA OR INDIAN GAZELLE (*GAZELLA BENNETTI*, SYKES.).

Three species of Gazelles inhabit the Indian Region:—The Indian Gazelle (*Gazella bennetti* Sykes), The Tibetan or Goa Gazelle (*G. picticauda* Hodgs.) and The Seistan Gazelle (*G. seistanica* Lyd.).

The Chinkara or Indian Gazelle is found practically all over the plains districts of India. It lives in small herds of 10 or 20 in waste lands broken up by nullahs and ravines, in scattered bush and thin jungle. It is common in the sandhills of the desert zone. In the Salt Range, Punjab, Chinkara have been seen as high as 4,000 ft. They do not enter forest; prefer broken country and live less in open level plains than Black Buck.

A buck Chinkara is 26 in. high at the shoulder and scales about 50 lbs. The horns which usually have 15 or 16 rings average from 10-12 in. They rarely exceed this length in Central or South India. The best heads come from the dry desert tracts of Rajputana and the North-West. The record is slightly over 16 in. Both sexes are usually horned. Though hornless females are not uncommon. The horns of the doe are smooth conical spikes usually about 4-5 in. long, slightly curved at the tip or straight and distinctly ringed at the base. Chinkara are less diurnal than Black Buck. They lie up earlier in the day and come out later in the evening. A Chinkara is a wary animal when feeding, always on the alert, always raising its head to look round. When alarmed the herd goes off at a wild pace and then stops at about 200 or 300 yds. on some eminence to turn and discover the cause of their alarm. Their food consists of grass, leaves, various crops and fruits such as gourds and melons. They go without water for long periods but will drink when they can get access to it. There is no regular breeding season. One or two fawns are born at a time.

The Tibetan Gazelle inhabits North-Eastern Ladak, the Tibetan Plateau and Shensi. It is a small gazelle, from 24-25 in. at the withers. Its slender close ringed horns rise vertically and curve sharply backwards. A good head tapes 12 in. The record is 15½ in. The summer coat is short and slate grey. In winter it is dense and pale fawn. The Seistan Gazelle, described from Siestan in Persia, is found in Baluchistan. The females are hornless. The horns of the bucks bend backwards and have their tips more or less distinctly in-turned. The greyish forehead of the older buck and the white muzzle and a whitish band at the base of the horns are distinctive.

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The Indian Gazelle or Chinkara (*Gazella bennetti* Sykes).
(*Height at shoulder 26 in.*).

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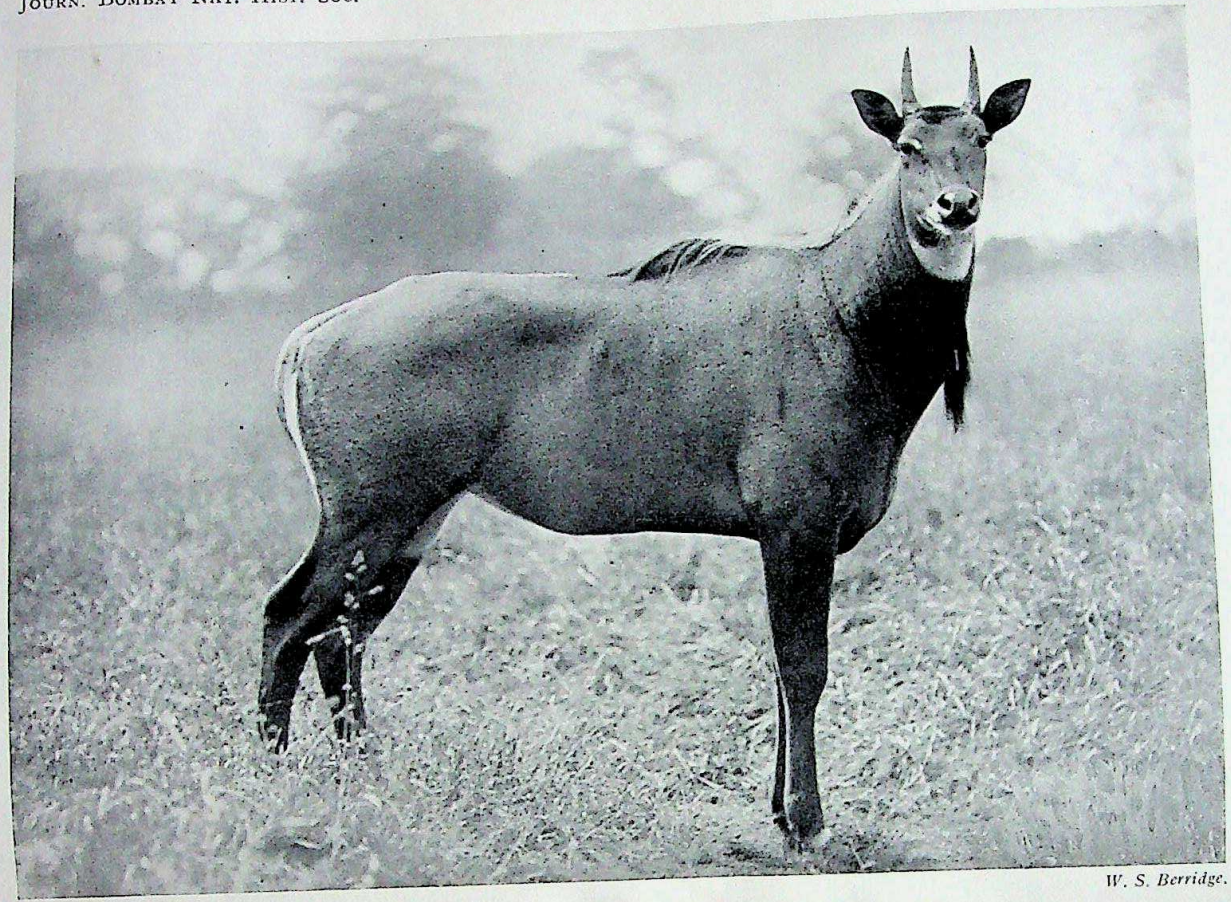

Photo by *W. S. Berridge.*

The Blue Bull or Nilgai (*Boselaphus tragocamelus* Pallas).

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Sub-Family V. *Tragelaphinae*: Tragelaphine Antelopes.

The Tragelaphine Antelopes form a fifth division of the Hollow-horned Ruminants. The group is more African than Indian. It includes the African Bushbucks, Kudus, Bongo and Elands. Only two forms are found in India:—the Nilgai and the Four-horned Antelope. Tragelaphine Antelopes are characterised by the general absence of horns in the females (except in two African genera). The horns of the males are not ringed; they are keeled in front and in most genera, such as Eland, Kudu etc., they are spirally twisted. The Indian genera are characterised by the shortness and straightness of their horns, the absence of distinctive body stripes and by the possession of face glands. The hoofs are not deeply cleft as in true antelopes and there are no foot glands. The structure of the foot is practically the same as in Bovines—the molar teeth again are semi-Bovine. Lateral or false hoofs are well developed in both limbs. The muzzle is naked and the tail long.

The distributional area includes Ethiopian Africa and Peninsular India. There is reason to believe that a Tragelaphine Antelope probably existed in the Euphrates Valley during the Assyrian period.

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THE FOUR-HORNED ANTELOPE (*TETRACEROS QUADRICORNIS* BLAINV.).

The Four-horned Antelope or *Chousingha* is the only Antelope with 2 pairs of horns. Of these the front pair are always the shorter. At times they are no more than horn-covered studs or mere bony knobs under the skin. The maximum length of the back pair is 4½ in., of the front 2½ in.

One of the most interesting features in this Antelope is the presence of a pair of well-developed glands between the false hoofs of the hind legs in both males and females. This is the only antelope which has such glands.

The *Chousingha* is about 25 in. high and scales near 50 lbs.

Its coarse coat is dull red brown above and white below. It lives in undulating or hill country and shelters in tall grass or open jungle—a terrain more usual to deer than to antelope. In this environment it has developed some of the habits of deer. It has a low whistling call, which the bucks repeat frequently in the hot weather and a sharp alarm note which the doe uses to guide her fawns through cover when in flight.

These little antelopes drink regularly. They are much more dependent on water than other antelopes and seldom live far from it. The edge of the jungle round a village tank is a favourite resort. Again, unlike antelopes they do not gather in large herds. *Chousingha* are usually seen alone or in pairs. In the early part of the year, before the rains, the female may be accompanied by one or two fawns. Sometimes two old animals and two young will be seen together, or even a buck with 4 or 5 does.

The Four-horned Antelope is found along the base of the Himalayas. It does not occur in the Gangetic plain. In the peninsula of India it has a more or less localised distribution. Here it keeps to the hill tracts covered with open forest. It is not found on the Malabar Coast.

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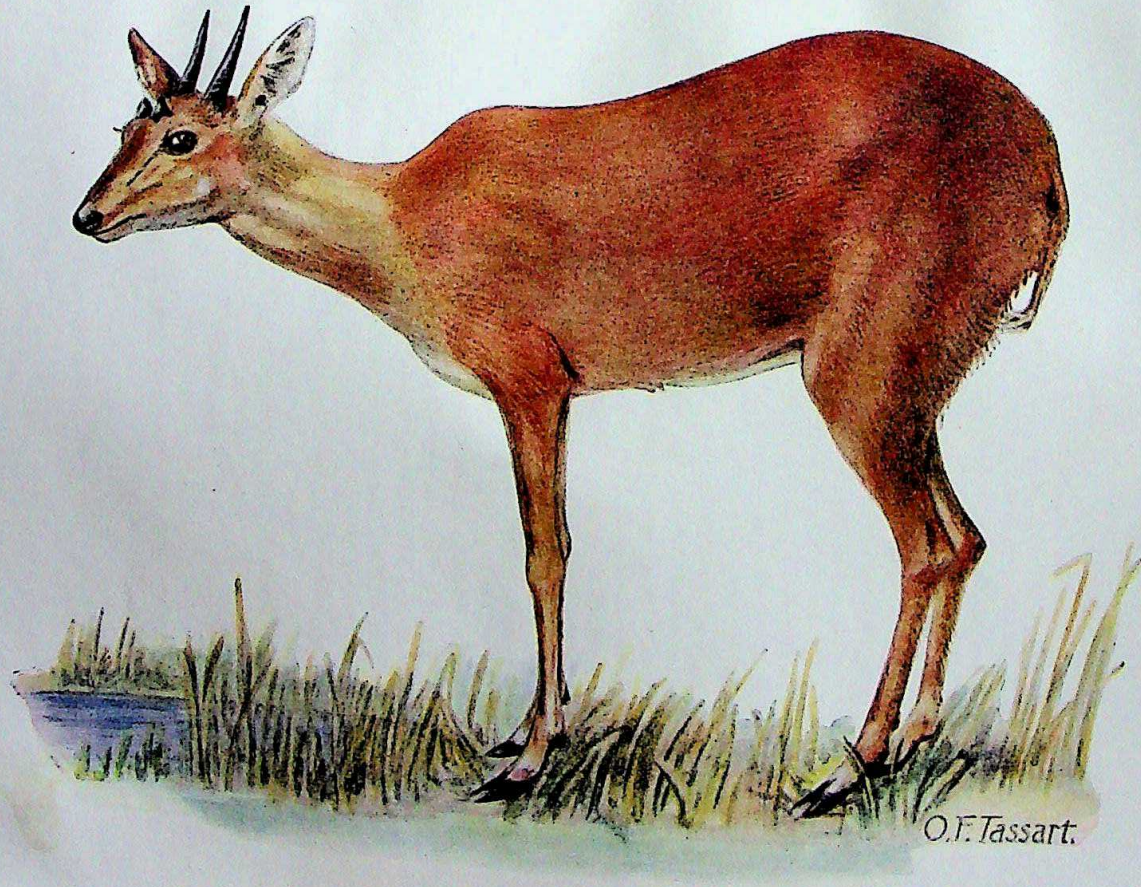

The Four-horned Antelope (*Tetraceros quadricornis*, Blainv.).
(*Height at shoulder about 25 in.*).

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The Nilgai or Blue Bull (*Boselaphus tragocamelus*, Pallas).
(*Height at shoulder 56 in.*).

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The Nilgai or Blue Bull (*Boselaphus tragocamelus*, Pallas). (*Height at shoulder 56 in.*).

THE NILGAI OR BLUE BULL (*BOSELAPHUS TRAGOCAMELUS* PALL.).

The Nilgai is a great ungainly antelope standing fully 54 in. at the shoulder and weighing about 600 lbs.

Its high withers and low hind quarters recall the build of the African Hartebeeste. As is usual with so many African Tragelaphines, the sexes differ in colour.

The adult bull has a coarse iron grey coat. He has a white ring below each fetlock and two white spots on each cheek. His lips, chin, the inside of his ears and the undersurface of his tail are white. Young bulls and the cows are tawny. Both sexes have dark manes and the males wear a distinctive tuft of stiff black hairs on the throat. The bulls have stout cone-like horns. They are distinctly keeled, triangular at the base and circular towards the tips.

Horns average about 8 in. The maximum length is $11\frac{3}{4}$ in.

Nilgai are usually seen in herds of 10-15 animals. Males are often solitary or perhaps several bulls will herd together. Females and young, attended or not, by one or two old males may be seen in smaller or larger parties. The country they live in may be level, undulating or hilly. They favour a mixture of grassland, scrub and cultivation, usually avoid really dense forest but will live in more or less open tree jungle.

They feed on grass and cereal crops and browse on leaves and wild fruit and are particularly fond of eating the fallen flowers of the Mowha tree. They feed at all times of the day.

When alarmed the herd goes off with an ungainly slouching gallop covering the most difficult ground with ease.

Nilgai droppings are commonly found heaped in one particular spot. This habit is common in many animals. It is suggested that the spot may provide *rendezvous* for reassembling the scattered members of a herd.

The period of gestation is 8-9 months. Young are seen at all seasons.

The Nilgai is found in the Indian Peninsula from the base of the Himalayas to Mysore. It does not occur in Eastern Bengal or Assam or on the Malabar coast. The sanctity attributed to it is the main source of its protection in many districts where it has survived.

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Family II. *CERVIDAE* OR DEER.

The last tribe of true ruminants is the Deer. Branching horns or antlers are the distinctive appanage of deer. Save in one or two aberrant forms only males carry them. In the Reindeer alone both sexes are horned. Deer, like other ruminants, are generally large and heavy creatures without the agility and litheness of beasts of prey. It is precisely to this sort of animal, where weight is an important factor, that horns are the most suitable weapons. They are perhaps a counterpoise to the teeth and claws of Carnivores. The need for defence against enemies, for weapons of attack in combats with their own kind has led to this distinctive form of protective armament among hoofed animals. But there is a distinction between the horns of oxen, sheep and antelopes and the deer tribe. A deer's horn when fully developed is really a mass of dead bone, devoid of any covering of skin or horn. The antlers are worn for a time, shed and then replaced. The budding antler grows from a pedestal or pedicel of bone which forms part of the skull. It appears as a velvety knob, grows rapidly, increasing in length by the vigorous deposition of bony matter. In young deer it remains a simple spike. In adult stags it branches into tines and takes the form of the complete antler. The new grown antler is highly sensitive. It is covered with 'velvet'—a thick soft skin, fed by numerous blood vessels and clothed with a mat of fine hair. When the growth of the antler is complete, a ring of bony matter, the 'burr', forms at its base just above its union with the pedicle. The bony ring constricts and cuts off the flow of blood to the antler. The blood vessels in the 'velvet' dry up. The 'velvet' shrinks and is eventually rubbed away by the deer. When present, it takes the place of the horny sheath which forms a permanent cover over the bony cores of the horns of cattle and other hollow-horned ruminants. But in the deer the outer cover of the antler is temporary. It is removed and leaves behind the dead bone which we call horn.

Besides the antlers, there are other characters which distinguish deer from other ruminants. Deer have a large fissure in the skull just in advance of the eye socket. As a rule canine teeth are present in the upper jaw. They are particularly well developed in forms which have no antlers such as Musk deer and Chevrotains.

Again, with the exception of the Musk deer, none of the tribe have a gall bladder. All deer have well developed lateral hoofs in both feet. The tribe ranges over a great part of Asia, North and South America and North-West Africa.

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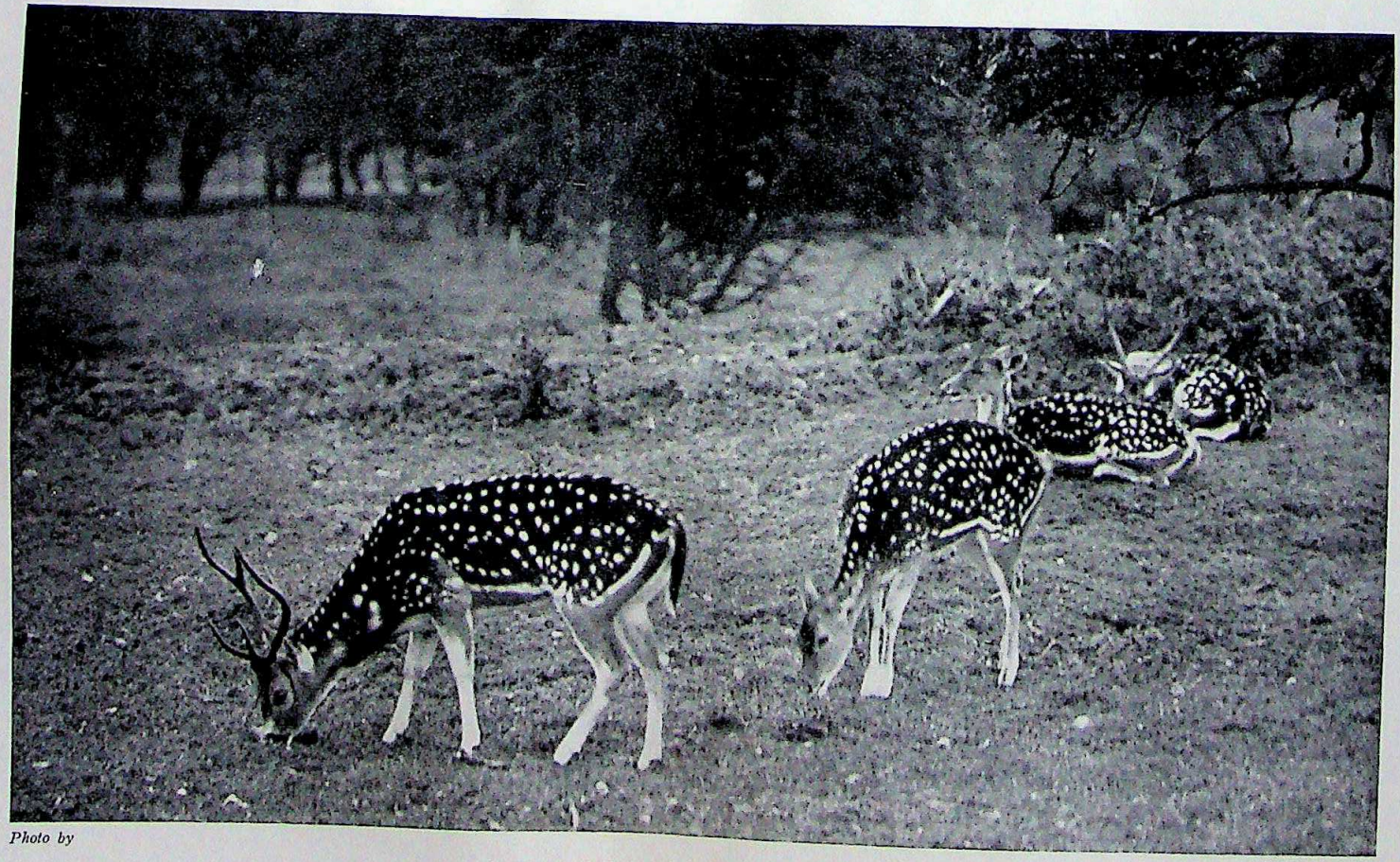

Photo by *W. S. Berridge.*

Axis, Spotted Deer, or Chital (*Axis axis* Erxl.).

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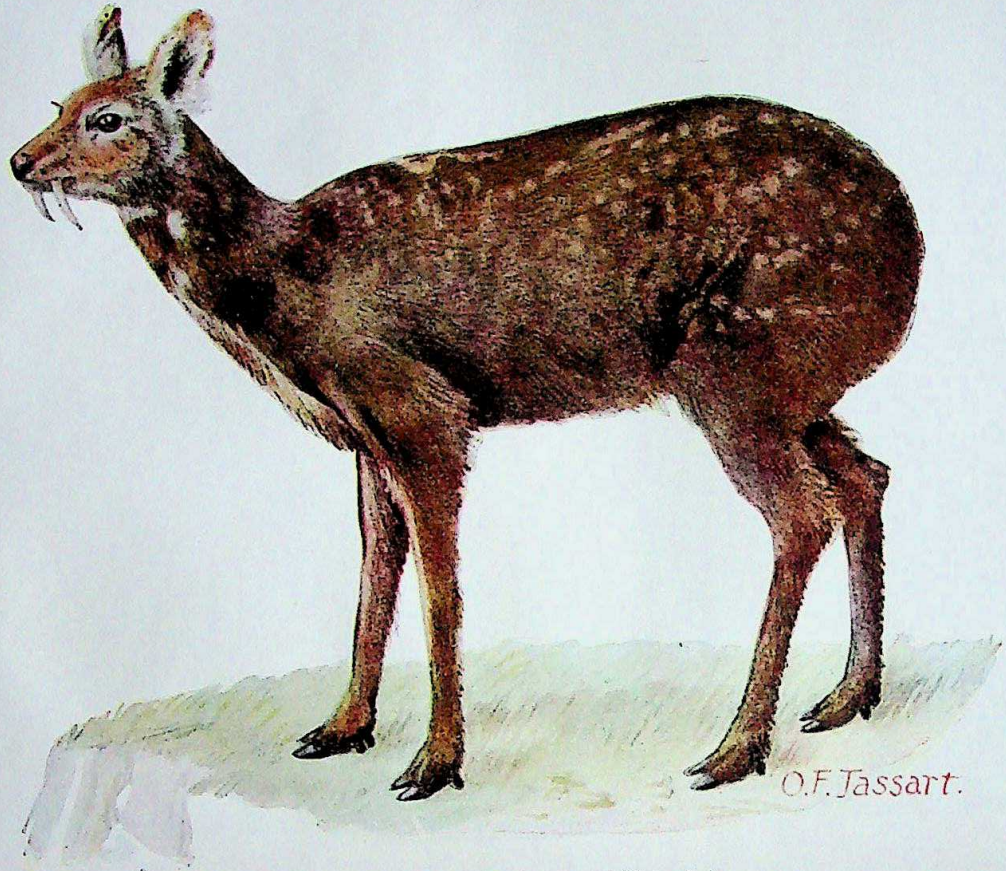

The Musk-Deer (*Moschus moschiferus* L.).

(*Height at shoulder 20 in.*).

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Sub-Family I. *Moschinae*: Musk Deer.

THE MUSK DEER (*MOSCHUS MOSCHIFEROUS* L.).

The Deer tribe is divided into two groups or sub-families—the *Moschinae*, containing a single genus and species the Musk deer and the *Cervinae* which includes all the remaining deer. The Musk Deer holds a place between the deer and the antelopes. It is regarded as an undeveloped form of deer which has not progressed with the rest of its tribe. It is hornless, has no face glands; these are generally present in all deer, and it has a gall bladder which no deer possesses. In some ways it has taken a special line of development of its own. This is seen in its possession of a caudal gland and a musk gland. The tail of a musk deer is peculiar. It is completely buried in the long hairs of the anal region and is for the most part naked except for a large tuft at the tip and a tuft at the base which covers its upper surface and sides. The lateral surface of the tail bears a narrow slit in its flacid skin which is the opening of the caudal gland. The musk gland is situated beneath the skin of the abdomen of the males. When fresh its secretion has an unpleasant pungent, urinary odour, when dry it acquires the scent of musk. Valued as a commercial product it induces the persecution of the species. From the great development of the caudal and musk glands it is inferred that in this deer the females seek out the males in the breeding season. Finally, musk deer have specially mobile feet, the hoofs are long and pointed and the unusually large lateral hoofs are well adapted to give it a foothold on snowy slopes and slippery rocks. The absence of horns is compensated by the great development of the canine teeth.

The Musk Deer is a little creature standing 20 in. at the shoulder and weighing as many lbs. It is protected from the cold by a deep coat of thick and bristly hairs, almost pithy in structure. The general colour is a shade of rich dark brown speckled with grey. It lives singly or in pairs. Musk deer are generally met with in birch forest above the zone of the pines, at times they come down to lower levels but always keep in thick cover. They scrape out a shallow form in which they lie concealed and come out to feed in the mornings and evenings.

The breeding season is believed to be in January and the young are born in June. Musk Deer range over a wide area in Central and North Eastern Asia. The typical form *Moschus moschiferous* is found in Kashmir, Nepal and Sikhim.

(*Height at shoulder 20 in.*).

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Sub-Family II. *Cervinae*: Deer.

THE MUNTJAC (*MUNTIACUS MUNTJAK* ZIMM.).

The second division of the Deer tribe—the *Cervinae* contains all the remaining deer. True deer have no gall bladder, no caudal or musk glands—all present in musk deer. With the exception of Roe deer, all deer have face glands. Again, all, save the Chinese water deer, have antlers and all of them, except the little Pudu deer of the Chilian Andes, have foot glands. The group contains 19 genera six of which are present in our area.

The Muntjacs, known also as Barking Deer, are small animals standing from 20-30 in. at the shoulder. The antlers are small. They consist of a short brow tine and a beam which is undivided and curves downwards and inwards at its extremity. The horns are set on long bony pedicels. A bony ridge extends down each side of the face from the base of each pedicel. The marked prominence of the facial ridges gives the creature the name 'rib-faced deer'. In females there is a bristly tuft of hair and a small projection in place of each horn.

Muntjacs range over the greater part of the Indo Malayan countries and are found also in China, Formosa and Japan. Various races are recognised over this wide range.

In our area there are supposed to be three: the Muntjac of North India is known as (*Muntiacus m. vaginalis*); the southern form is (*M. m. aureus*). The third race (*M. m. grandicornis*) is found in Burma. The Muntjac of Tenasserim (*M. feae*) is regarded as a distinct species. The coat of the Burmese Muntjac is described as tawny yellow; the North Indian race is bright chestnut. A bright red form is equally common in Burma. The antlers of an adult male in Burma average 4 in., their bony pedicels measuring from 2-4 in. The best Burmese head is 7 in. Average Indian antlers measure from 2-3 in. The pedicel 3-4 in. The maximum length obtained in the C.P. is 7 in. A good buck weighs from 48-50 lbs. Horns are shed during May and June. The Muntjac is a solitary animal. It is seen singly or in pairs; more rarely, in small family parties. It keeps to more or less thick jungle and comes out to graze in the outskirts of forest or in open clearings. It is fairly diurnal in habit. The food consists of various leaves and grasses and wild fruits. Its call from a distance sounds much like the bark of a dog. It is given out at intervals; usually in the mornings and evenings, sometimes after nightfall.

When alarmed and in flight these deer give out a series of short cackling barks which may be reduced to a sharp rattle likened to the sound of castanets. Muntjac appear to breed at all seasons. The rut mainly takes place in the cold weather. The young usually one—sometimes two, are born at the beginning of the rains. The young are spotted white till about 6 months old.

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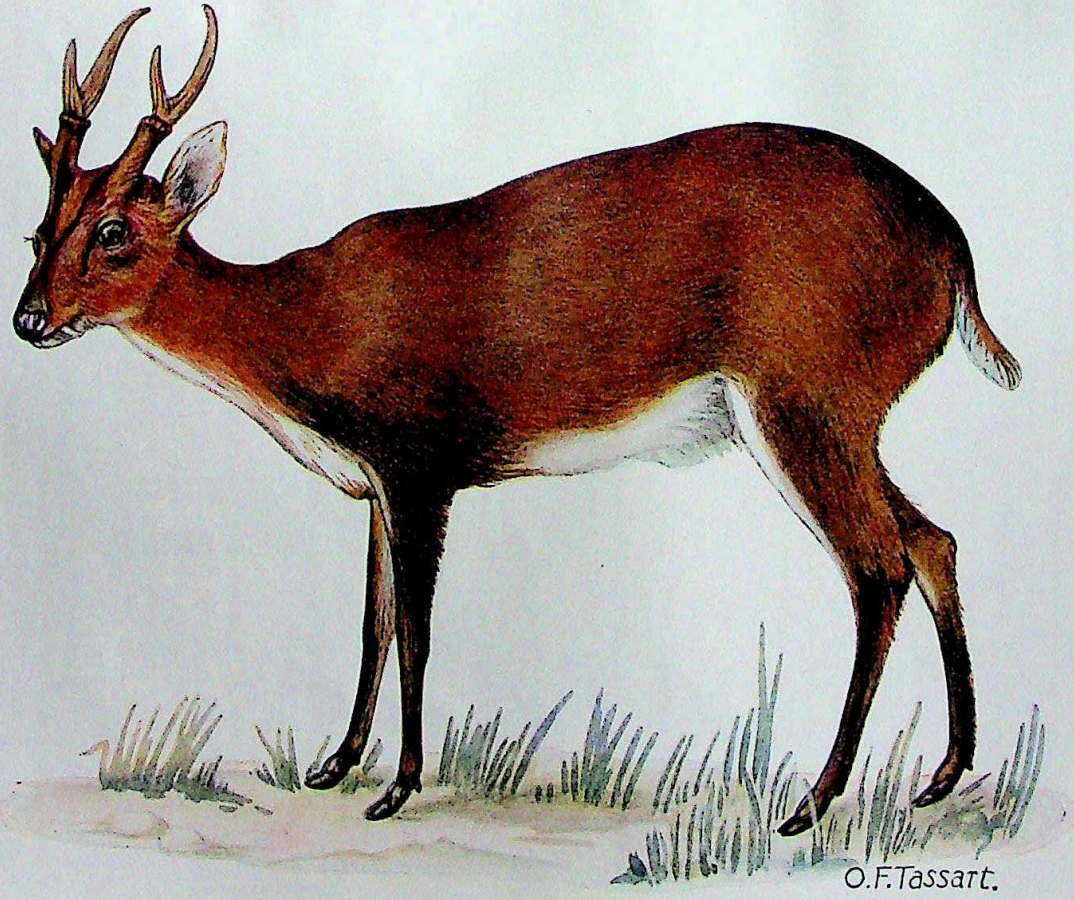

The Muntjac or Barking Deer (*Muntiacus muntjak* Zimm.).

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The Chital or Spotted Deer (*Axis axis* Erxl.).
(*Height at shoulder 36 in.*).

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THE CHITAL OR SPOTTED DEER (*AXIS AXIS* EXRL.).

The Chital, perhaps the most beautiful of all deer, is found only in India and Ceylon. In India, it is found in the forests at the base of the Himalayas and practically throughout the peninsula wherever there is more or less open jungle combined with good grazing and a plentiful supply of water. It is unknown in the arid plains of the Punjab, Sind, in a large portion of Rajputana, in Assam and the countries east of the Bay of Bengal.

The Spotted Deer is at its best in the Himalayan foot hills, in the jungles of the Terai and in the Central Provinces. A well-built stag from these parts stands 36 in. at the shoulder and weighs about 190 lbs.

In South India, or in the jungles of the Sunderbans, the height seldom exceeds 2 ft. 6 in. The coat is a bright rufous fawn profusely spotted with white. The lower series of spots on the flanks are arranged in longitudinal rows and suggest broken linear marking. Its dappled hide almost obliterates the chital in a sun-flecked jungle, particularly when it sits down to rest as it usually does, in some shady place.

The graceful antlers have 3 tines—a long brow tine set nearly at right angles to the beam and two branch tines at the top. The outer tine, the continuation of the beam, is always the longer.

The record head measures 39¾ in. A 34 in. antler would be good anywhere; 31 in. in South India.

One always associates Chital with beautiful scenery, with grassy forest glades and shaded streams. They are seen in herds of ten to thirty, which may contain two or three stags; but assemblages numbering several hundred have been met with. They do not shun the proximity of villages, enter cultivation and frequently associate with many forest animals, particularly with monkeys. They are less nocturnal than sambar and feed till late in the morning and again in the afternoon, and lie down in the interval in some shaded spot.

The time at which the stags shed their antlers varies in different localities. In the Central Provinces and South India, as a rule, stags cast their horns in August and September. The new antlers are in velvet till the end of December. But stags carrying horns in various stages of development have been seen at all seasons. It is suggested that regularity in the intervals at which antlers are shed is only attained by fully mature stags. In the Central Provinces, the pairing season is at its height in May. The rutting stag has a loud harsh bellow and combats between males for the possession of the hinds are fierce and frequent. In North India the pairing is said to take place during the winter months. Fawns may be met with at any season. One to three are born at a time —two being the commoner number. Chital are prolific breeders; an interval of 6 months may see the production of a new family.

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THE HOG DEER (*HYELAPHUS PORCINUS* ZIMM.).

The name Hog Deer has been probably suggested by the squat pig-like appearance of this animal and by its hog-like movements. When running it keeps its head low down, moves without that bounding action so characteristic in deer.

The Hog Deer is a relative of the Chital but is smaller and stouter in build. The body is long and the legs relatively short. The height at the withers is about 27-29 in. The fur is brown, dark brown in old stags, with a yellowish or reddish tinge. The white tips to the individual hairs give the coat a speckly appearance. The under parts of the body are paler and the inside of the ears and the underside of the tail are white. The young are spotted. Some young stags and hinds show these spots though they are not always discernible. The summer coat is generally paler.

The small antlers are set upon very long bony pedicels. After giving out a short brow tine the beam is almost straight till it divides into a shorter fore and longer hind tine. Average horns measure from 12-15 in. Burmese stags carry better heads than Indian. The record is 24 in. Hog deer favour grass jungles by the banks or rivers, grass-covered delta islands or open grass plains; always where the grass is not too high. On the banks of the Indus in Upper Sind they live in scrub jungle and in Burma, they were once common in mangroves. Hog Deer are generally solitary creatures. A pair will continue to frequent a particular stretch of grassland. Sometimes small parties of 2-5 may be found grazing together. They come out to feed early in the mornings and in the evenings, and shelter in long grass during the hot hours of the day. They are wary creaures; their sense of sight, smell and hearing is acute. Persecution has made them almost nocturnal in many parts of their range.

The main pairing season is believed to be in September and October and the young are dropped in April and May. Pairing must also take place earlier in the year as young are often born during the rains. The period of gestation is 8 months. The Hog Deer is not found in the Indian Peninsula. It lives in the low alluvial grass plains of North India from Sind and the Punjab to Assam whence its range extends into Burma and Tenasserim.

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The Hog-Deer (*Hyelaphus porcinus* Zimm.).
(*Height at shoulder 27-29 in.*).

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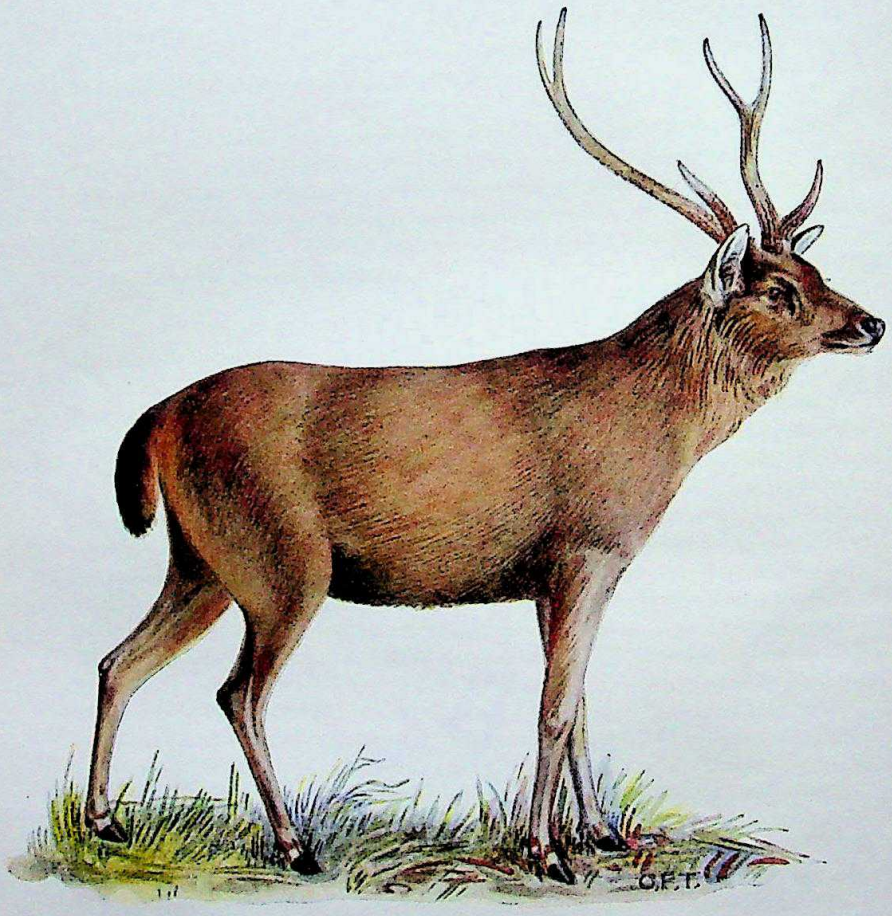

The Sāmbar (*Rusa unicolor* Kerr.).
(*Height at shoulder 5 ft.*).

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THE SAMBAR (*RUSA UNICOLOR* KERR.).

The Sambar is the typical forest deer of South Eastern Asia. In the Indian Empire it is represented by the Indian Sambar (*Rusa unicolor*), whose range includes Ceylon and by the Malay Sambar (*Rusa unicolor equinus*), which inhabits Assam, Burma and the Malay countries.

Of the many races of Sambar, the Indian is the largest and carries the grandest horns. It is a heavily built deer which may reach a shoulder height of nearly 5 ft. The average height is about 55 in. A full grown stag scales from 500-600 lbs. The coat is coarse and shaggy. In stags it forms a mane about the neck and throat. In the hot weather much of the hair is shed. The general colour is brown with a yellowish or greyish tinge. The under parts are paler. Females are lighter in tone. Old stags tend to grow very dark—almost black. The antlers are stout and rugged. The brow tine is set at an acute angle with the beam. At its summit, the beam forks into two nearly equal tines. In some heads the outer, in others the inner tine is longer. The full number of points are developed in the fourth year. The Sambar stag is said to be at its prime in its ninth year. Really old beasts carry poor heads. Sambar from the Himalayan foot hills have more rugose and perhaps more massive antlers than those of the C.P., but they are never so long or so graceful. The finest heads come from the forests about the Narbada and Tapti and from the Central Provinces generally. The record is the famous head from Bhopal which tapes 50⅞ in. The horns of the Malay Sambar are set closer. They have a more rugged and massive appearance. The average length is 26 in. A head over 30 in. is good.

Forested hill sides, preferably near cultivation, are the favourite haunt of Sambar. Their food consists of grass, leaves and various kinds of wild fruit. They feed mainly at night and retire into heavy cover at day-break and do not come out till dusk. The capacity of so heavy an animal to move silently through dense jungle is amazing. Their powers of sight are moderate; their scent and hearing acute. Sambar take to water readily and swim with the body submerged only the face and the antler showing above the surface. There is much variation both as to the pairing season and the time at which the antlers are shed. Stags in velvet and others with mature horns are seen together. In Central and Southern India the majority of stags cast their antlers between the end of March and mid-April. The horns commence to grow in May and are in velvet during the rains. In September, the stags commence to clean their horns by rubbing them against trees. The tree is taken between the brow tine and beam and the antler is rubbed up and down leaving a long blaze on the bark. Most of the stags are clear of velvet by November. They roar in challenge to each other. The challenge is a loud metallic bellow quite distinct from sharp short 'ponk' which is the alarm note. The males fight for territory. Each stag fights to obtain sole rights over some favoured valley. The victor becomes master of

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the hinds which enter it. The hinds are attracted to the stags by their calls and the scent of the face glands, which are everted during the rut and give out their strong smelling secretion. Pairing takes place in November and December. The stag's harem is limited to a few hinds. After the rut he deserts them and lives a solitary life till the return of the mating season. The young are born at the commencement of the rains, in late May or early June. Young stags remain with the hinds. Sambar are rarely found associating in large numbers. Four or five to dozen are what one usually sees. Both stags and hinds are seen singly or a party of hinds and fawns without a stag.

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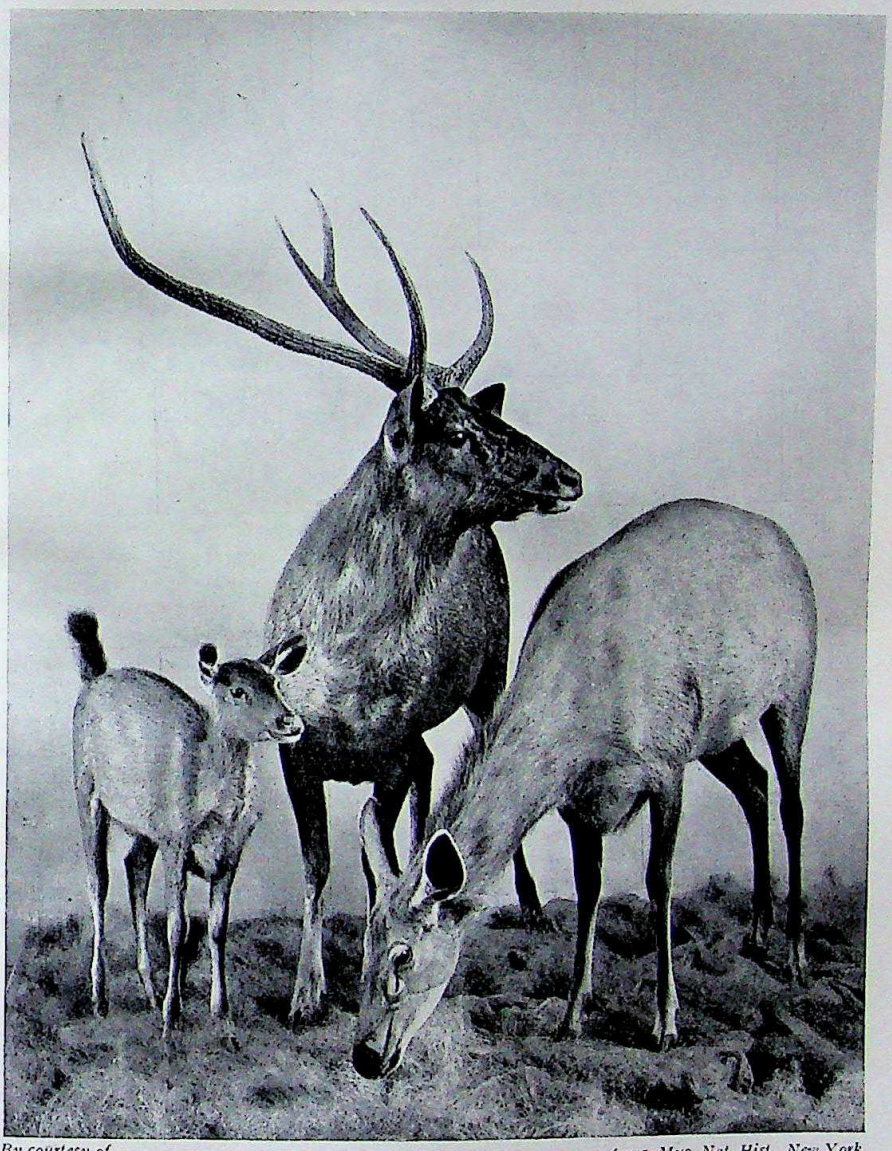

By courtesy of *Amer. Mus. Nat. Hist., New York.*

The Sambar or Rusa Deer (*Rusa unicolor* Kerr.)

(*Height at shoulder 5 ft.*).

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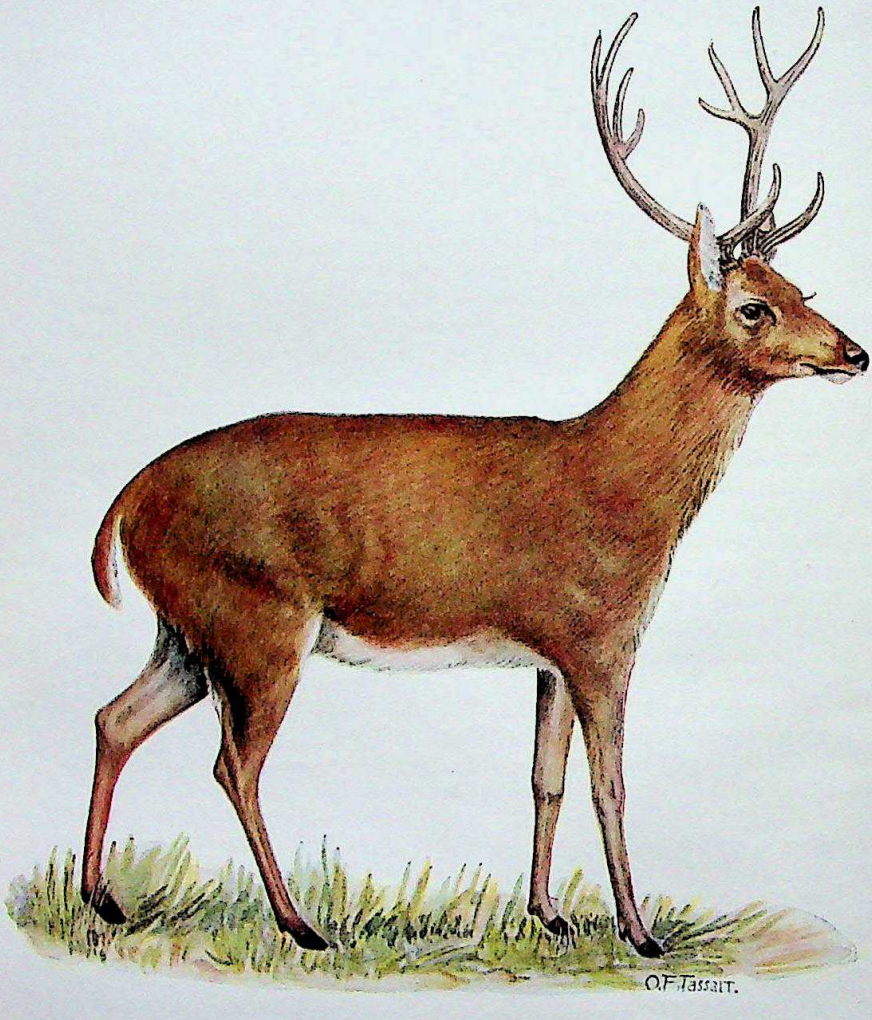

The Swamp Deer (*Rucervus duvaucelli* Cuv.).
(*Height at shoulder 54 in.*).

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THE SWAMP DEER (*RUCERVUS DUVAUCELLI* CUV.).

The Swamp Deer group, forming the genus *Rucervus* contains three species within our area:—The Swamp Deer (*Rucervus duvaucelli*), Eld's Deer (*Rucervus eldi*) of Manipur and the Thamin (*Rucervus thamin*) of Burma.

The Swamp Deer—the *Barasingh* of the Central Provinces and the *Gond* of the United Provinces and Terai is found in the Central Provinces, the United Provinces, parts of Assam and the Sunderbans. Its occurrence in Sind is doubted.

This splendid deer attains its finest development in the Central Provinces. A good stag stands 54 in. at the shoulder and scales from 370-400 lbs. Its coat almost woolly in texture shades from brown to yellowish brown. The stags are maned and darker in colour. The summer coat of stags and hinds is paler, some develop spots, not always distinct, of lighter tone. The young are spotted.

There is much variation in the form of the antlers. Two distinct types are recognised with a wide range of intermediary patterns. In the first form, the beam takes a backward and then forward curve bringing the points of the horns in line with the top of the head. Half way up the beam, tines are given off at intervals: the first usually having a shoot of its own. In the second and far handsomer type, the brow tine is set at right angles to the beam, which grows with an outward curve giving the antlers a wider spread. At the point where it branches, the beam takes an almost horizontal curve and gives off number of vigorous vertical tines each of which throws out shoots. The whole effect is to produce an extraordinarily beautiful form of antler. Antlers from the Terai are smoother and whiter than C. P. heads. Heads exceeding 41 in. are rare. 10-14 is the usual number of points, though antlers with as many as twenty points have been obtained. The term Swamp Deer exactly suits the animal in the Terai where it lives in marsh land and is seldom out of water. In the Central Provinces this deer lives in grassy plains on hard ground and is, on the whole, less dependent on the proximity of water than the Chital. In Assam they usually live in high ground in the proximity of water. Swamp Deer are highly gregarious. In parts of the Terai a few miles of swamp may contain thousands of these magnificent animals. Swamp deer are less nocturnal than Sambar. They feed till late in the morning, again in the evening and lie up during the day. Their eyesight and hearing is moderate. The sense of smell acute. When alarmed the whole herd sets up a shrill baying sound which is continued in flight. In Assam the antlers are shed in February and March. The new antlers appear between April and May. They are in velvet till the end of July and are clean by the end of September. In the U.P. and C.P. stags are hornless by mid-April. Horns are mostly in velvet between May and August. They harden in September and are generally clear of velvet by mid-October. The master stags assemble.

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Their eerie and penetrating roars are thrilling and impressive. They live more or less in amity till the rut develops. In the C.P. this is mainly between mid-December and mid-January. In the U.P. the chief rutting season is in November and December. The males fight for the possession of the hinds and each master stag so acquires his harem which may number as many as 30 hinds. It is reported that in Assam the pairing season is in April and May when the stags' new antlers are beginning to sprout!

With the cooling of their short-lived ardour the stags desert the hinds. The master stags collect again in small herds. The younger males remain with the hinds. The finest stags go off to live alone or in company with another of equal development. The young are born just before the rains. In Assam the young are born mainly between December and January or as late as February.

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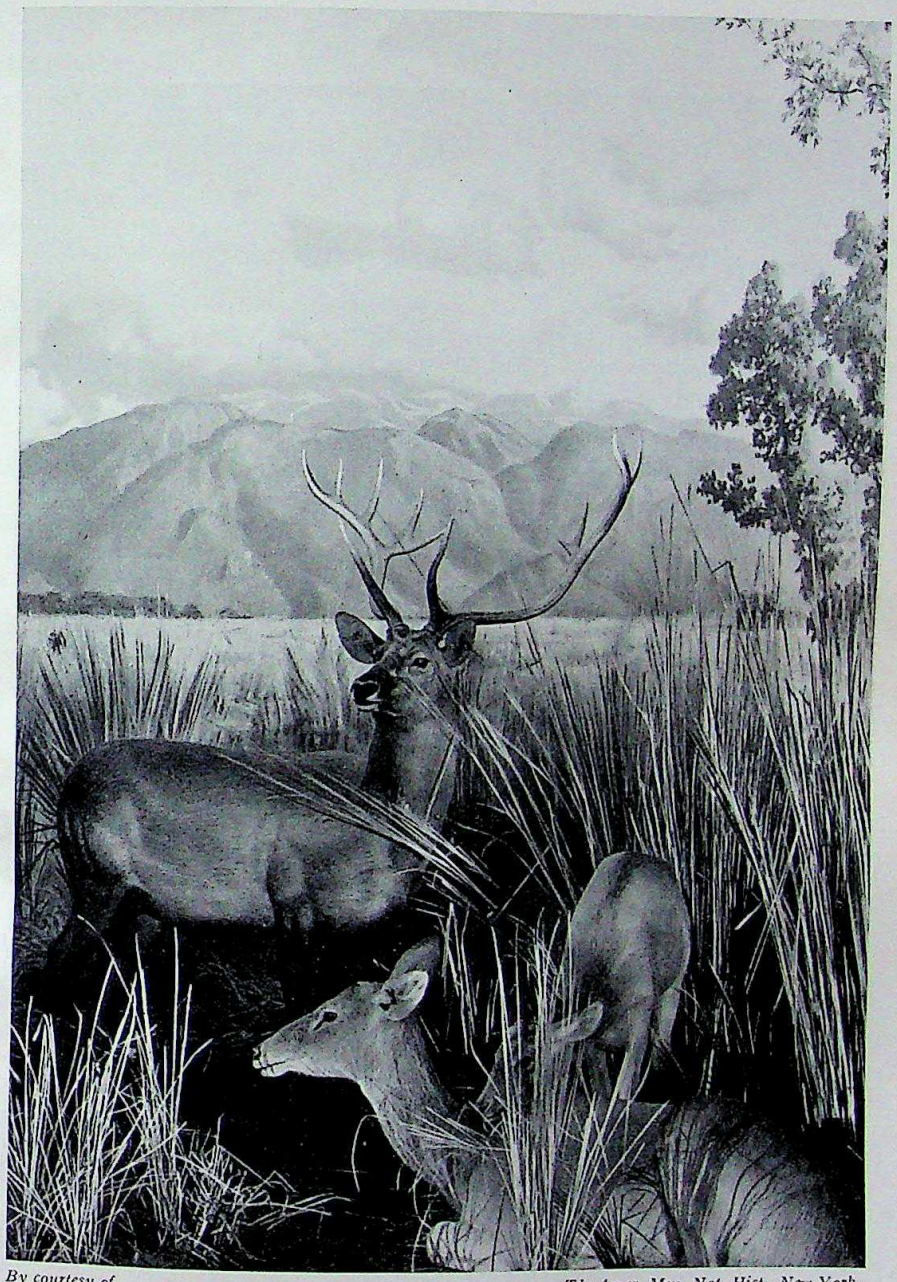

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Swamp Deer (*Rucervus duvaucelli* Cuv.).

(*Height at shoulder 54 in.*).

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The Brow-antlered Deer or Thamin (*Rucervus eldi* McClell.).
(*Height at shoulder nearly 4 ft.*).

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THE THAMIN OR BROW-ANTLERED DEER (*RUCERVUS THAMIN* THOS.).

The Thamin, the typical deer of Burma, is found mainly in the dry zone of Central Burma. It is sparingly distributed in other parts of the Province. It was once found in immense numbers in the wide plains of Pegu.

This beautiful deer is nearly 4 ft. high at the withers. The hinds are smaller. The coat is coarse and sparse. In stags it is dark brown or nearly black. Stags have a dense mane or ruff about the throat. Hinds are a light fawn. The young are spotted. There appears to be a seasonal colour change; the dark brown thamin of the cold season developing into the yellowish brown animals of the hot weather. The close set antlers are very handsome. In profile their form is almost circular. From the tip of the brow tine to the point of the beam the antler sweeps in one continuous, graceful curve. The number of terminal tines varies from two or three to as many as eight or ten. There are supposed to be two races of Thamin in Burma. The typical thamin and Bruce's Thamin (*R. thamin brucei*), described from the Ruby Mines District, in which the horns are said to be slightly palmated. The maximum length of the antlers is 42 in. Heads over 35 in. are good. Stags are believed to acquire their horns in the second year and reach their prime when 7 years old.

Thamin avoid hills or heavy forest. These Deer prefer open scrub jungle on flat or undulating land between rivers and hill ranges. They live in small herds, lying up in cover during the heat of the day and feeding in the mornings and evenings. After nightfall, they come out to graze in the large *lwins* and *kwins* or to raid crops in their vicinity. Their speed and sharp sight is their main protection.

Stags shed their antlers in mid August and are clear of velvet by the end of December, when the horns are at their best. The rut develops between March and April. The period of gestation is 8 months. The fawns, one at birth, are dropped mostly in October. After the rut the master stags go off either alone or attended by one or two hinds. Big stags are seldom seen with the herds after May.

Eld's Deer (*Rucervus eldi*) is confined to Manipur where it lives in grassy swamps. Its antlers are indistinguishable from the Thamin. The hind pasterns are horny instead of hairy and applied to the ground when walking.

Thamin have suffered much from persecution in Burma. Without effective measures for their protection this beautiful deer must face extinction.

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THE KASHMIR STAG OR HANGUL (*CERVUS CASHMIRIENSIS* FALC.).

The Red Deer of Europe typifies a group of large deer consisting of several species and varieties distributed over Europe, Asia, north of the Himalayas, North Africa and North America. The best known Asiatic species is the *Hangul* or Kashmir Stag. Its range is limited to the north side of the valley of Kashmir and some of the adjacent valleys.

The Kashmir Stag is smaller than the Sambar. It is from 48-50 in. high at the withers. A well grown stag scales a little over 400 lbs. The coat ranges from light to dark brown, fading to dingy white on the lips, chin, underparts and buttocks. The colour fades during the summer but tones up with the denser winter coat, which, in a big stag, is very dark or rufous brown. Fawns are spotted. Old hinds may show white flecks. The fine spreading antlers assume great variety in form. Normal heads have 5 points on each antler. Heads with 16 points have been obtained, 14 pointers are rare; 13 and 11 more common.

The Kashmir Stag is essentially a forest animal. These deer are found singly or in small parties. They seldom remain long in one area but roam from forest to forest to find good grazing. Stags shed their antlers between mid March and April. Young stags may carry their horns upto the middle of May. After shedding their antlers most stags go up hill and congregate about the snow line. They spend the summer at an elevation of 9,000 to 12,000 ft. About the end of September the stags' new antlers have hardened. They commence to roar and challenge. They join the hinds at the beginning of October and, as the rut develops, engage in conflict. The master stags collect a number of hinds whose possession is disputed by rivals. In November, when the dry leaves cover the ground, the stags desert the hinds and go to the upland meadows or into the horse-chestnut forests. In hard winters the deer descend to lower levels. They come to the lower elevations in the early spring to feed on the new sprouting grass and the budding larches. The fawns are born in April.

The Chumbi Valley in Tibet and some of the adjacent valleys of Bhutan are inhabited by another species of the Red Deer group —the Shou (*Cervus affinis*). It is also called the Sikhim Stag though its existence in Sikhim is doubted. The Shou is much larger than the Hangul, standing from 4½ to 5 ft. at the shoulder. Its antlers are longer and more massive. Their distinctive feature is the forward bend of the beam at the junction of the third tine.

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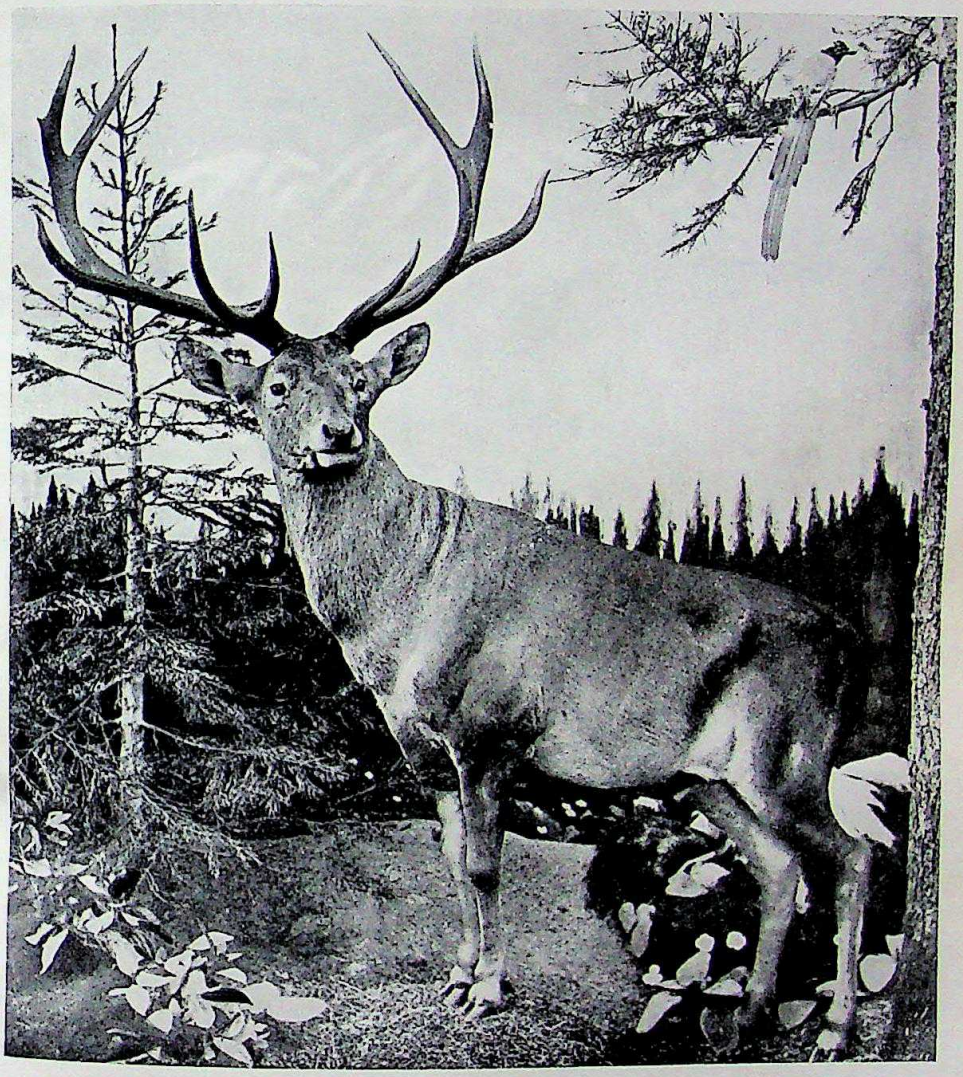

The Kashmir Stag or Hangul (*Cervus cashmiriensis* Falc.).
(*Height at shoulder 48-50 in.*).

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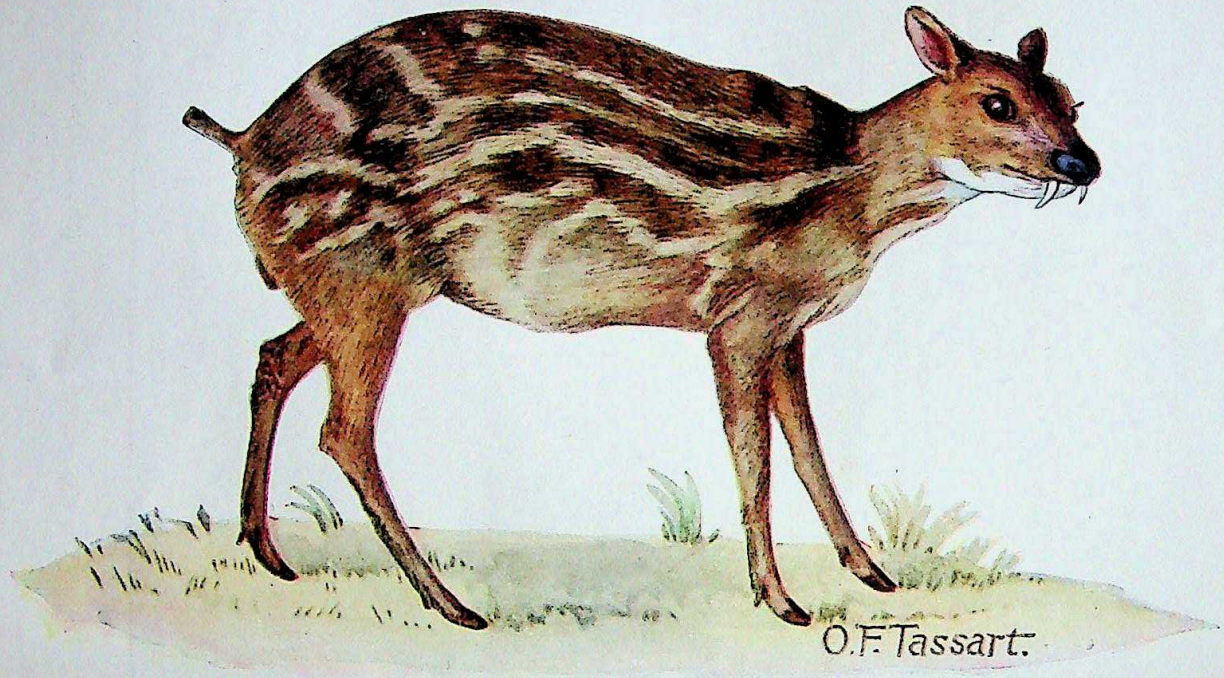

The Indian Chevrotain or Mouse Deer (*Moschiola meminna* Erxl.)

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SECTION *TRAGULINA*.

CHEVROTAINS OR MOUSE DEER.

The cloven-hoofed animals which we have considered so far all belong to one great division—the *Pecora* or Ruminants. The Mouse Deer represent a second division. They are true ruminants and, like ruminants, have no front teeth in the upper jaw. But they differ in having a three-chambered stomach in place of one with four divisions. They have four well-developed toes on each foot, the bones of the petty or side toes being complete. In true ruminants some of these bones are imperfect or wanting. Antlers are not developed. Mouse Deer, like Musk Deer, are furnished with tusks. These are better developed in males. Mouse Deer are included in a single family the *Tragulidae* which contains three genera: (1) The Indian Chevrotain (*Moschiola*), (2) The Malay Chevrotains (*Tragulus*) and (3) The African Water Chevrotain (*Hyemoschus*). The Asiatic Chevrotains are distinguished from the African by having true cannon bones developed.

The Indian Chevrotain or Mouse Deer (*Moschiola meminna*) is a tiny little creature no more than 10 or 11 in. high. Because of its small size, shy habits and very protective colouring it easily escapes observation. Its coat is olive brown speckled with yellow. The flanks are marked with rows of buff or white spots. The lower parts are white. The throat has three white stripes. The Malay Chevrotains are distinguished from the Indian by having the skin on the chin and throat naked instead of hairy. Their coats are not spotted. There are two species in Burma—the larger Malay Chevrotain (*Tragulus canescens*) and the Lesser Malay Chevrotain (*Tragulus kanchil ravus*). The former is about 28 in. long and 13 in. high, the latter is no longer than 18 in. from the tip of the nose to the root of the tail. The smaller animal has three white stripes on its throat, the larger five. Both species are common in the forests of Tenasserim.

All Chevrotain have similar habits. The Indian Mouse Deer shelters in grass covered rocky hillsides or in forest. It conceals itself in the crevices of rocks or among large boulders, coming out to feed in the mornings or evenings and never venturing far out into the open. In these 'hides' the female brings forth her young, generally two in number, at the end of the rains or the commencement of the cold season. The males live solitary except during the pairing season. The Indian species is found in Central and Southern India. The Malay species live in dense thickets. Like the Indian species they pair in June or July.

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SECTION *SUINA*.

PIGS, PECCARIES AND HIPPOPOTAMUSES.

The Chevrotains represent, as was shown, a group of animals somewhat distinct from the true ruminants. Pigs, Peccaries and Hippopotamuses are a stage yet further removed from typical ruminants. They form a third section of the *Artiodactyla*. Their feet, like the feet of the Chevrotains, have the bones of the 4 toes complete. All these pig-like animals have incisor teeth in the upper jaws. Their molar teeth when unworn are capped with small hillock-like columns which do not wear down to crescentic patterns seen in the grinding teeth of ruminants. As they are not ruminants their stomachs are much less complex and may, as in the pigs, consist of a single chamber.

Finally, cannon bones are not developed in the feet, the bones which fuse to form a cannon bone in true ruminants remain distinct in these animals. These pig-like animals represent a more primitive type which existed at a time when ruminants were unknown and which formed the ancestral stock from which they have descended.

The Peccaries are exclusively American in their distribution. Hippopotami are now limited to Africa but many species once inhabited India. They were probably contemporary with the Stone Age Man in this country.

The Pigs (*Suidae*) are the only representatives of the division in our area. There are two genera: (1) the Wild Boar (*Sus*) and (2) the Pigmy Hog (*Porcula*). An elongate head with an abruptly truncated mobile snout, ending in a flat disc containing the nostrils is distinctive in pigs. Their feet are narrow. The petty toes are completely developed but do not reach the ground when walking. The upper canines curve upwards and outwards.

The Pigmy Hog is closely related to the typical Pigs. On account of its small size, short tail and the presence of three pairs of teats instead of 4, it is regarded as a separate genus. Though a single species of wild boar is now found in India, in the Eocene Period six or seven species inhabited the country—one of them a monster form, the largest known of its race.

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The Indian Wild Boar (*Sus cristatus* Wagner).

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Family IV. *SUIDAE*, PIGS.

THE INDIAN WILD BOAR (*SUS CRISTATUS* WAGN.).

The Indian Wild Boar is widely distributed. It ranges over nearly the whole of India, Burma and Tenasserim, Siam and part of the Malay Peninsula. It is also found in Ceylon.

A well grown male stands about 36 in. at the shoulder. It is believed to be a larger animal than the European Boar with a sparser coat and a fuller crest or mane. The weight of an adult may well exceed 300 lbs. The tusks are well developed in the males both the upper and lower curve outwards and project from the mouth. The lower tusks in a large boar are said to have measured 12 in. including the portion embedded in the jaw. But they rarely exceed 9 in.

The tame pig of India is probably derived from the wild. The two probably interbreed when opportunity offers. The colour is black mixed with grey, rusty-brown and white hairs. The young are browner and old boars greyer. New born wild pig are brown with light or dark stripes.

The Indian Wild Boar lives in grass or scanty bush jungle—sometimes in forest; after the rains, quite commonly in high crops. They are omnivorous living on crops, roots, tubers, insects, snakes, offal and carrion. They feed in the early mornings and late in the evening and, where much disturbed, chiefly at night. No animal is more destructive to crops and, in cultivated areas, it is impossible to make a plea for its protection.

Wild Boar display great intelligence, and few animals show greater courage and determination. The sense of smell is acute, the eyesight and hearing moderate. Wild Boar are highly prolific. They apparently breed at all season. In Central India the majority of young are born at two periods shortly before or after the rains. Boars and sows are known to collect in large assemblies when pairing. A herd of 170 or more were seen by Mr. Dunbar Brander. They were collected in a circle, the master boars in the centre. Two males were fighting—two others had fought; the rest were passive though interested spectators. The period of gestation is said to be four months—4-6 young are born at a time. The mother shelters them in a heaped up mass of grass or branches which she builds before she litters.

After breeding the big boars live alone or in company with another of equal size or with one or two sows.

The Pigmy Hog (*Porcula salvania*) inhabits the forests at the base of the Himalayas in Sikhim, Nepal, Bhutan and in Assam. Its habits are similar to those of Wild Pig. It is said to live in herds of 5-20. It is nocturnal and rarely seen.

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The Indian Wild Boar (*Sus cristatus* Wagner).

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PERISSODACTYLA: ODD-TOED UNGULATES.

It has been shown that there are four main divisions or Orders of hoofed animals and that all those considered so far, belong to the first and largest division the Artiodactyla or Even-toed Ungulates. The salient feature which distinguishes the even-toed ungulate lies in the arrangement of its toes. The axis of the foot—a line drawn down its middle—passes between the third and fourth toes. These two toes are large and equal in size. The hoofs which encase them appear like a single hoof cleft in two. This prominence of the third and fourth toe is accompanied by the diminishing in size of the second and fifth and the complete disappearance of the first toe. This is the general plan of structure in the feet of oxen, sheep, goats, deer and pigs.

With Horses, Rhinoceroses and Tapirs we come to an assemblage of animals differing in many important respects from those so far described. Their most obvious distinction is again displayed in the structure of the feet. Like the even-toed ungulates they are descendants of 5-toed ancestors. But with them it is the third or middle toe of the foot which has increased in size at the expense of the others. The number of toes varies. A Tapir has four and a Rhinoceros three toes on the fore feet. Both have only three on the hind. The foot of a horse has but one functional toe. But in all these animals it is the third or the middle toe of the foot which is most prominent. It is always symmetrical in itself and always larger than the other toes, when these are present. This pre-eminence of the third or middle digit of the foot gives this group of animals its name—*Perissodactyla* or Odd-toed Ungulates. With them, except in the case of the Tapirs, the number of toes in each foot is usually odd—either one or three. The Odd-toed ungulates are further marked by having their molar and pre-molar teeth in one unbroken series, the posterior molars resembling the pre-molars in shape and size.

The Odd-toed ungulates are poorly represented at the present day. Horses, Rhinoceroses and Tapirs are the only surviving members of a group of animals which flourished in great variety during the earlier Tertiary period. With the exception of the Tapirs which are found also in Central and South America all the existing odd-toed ungulates are Old World animals.

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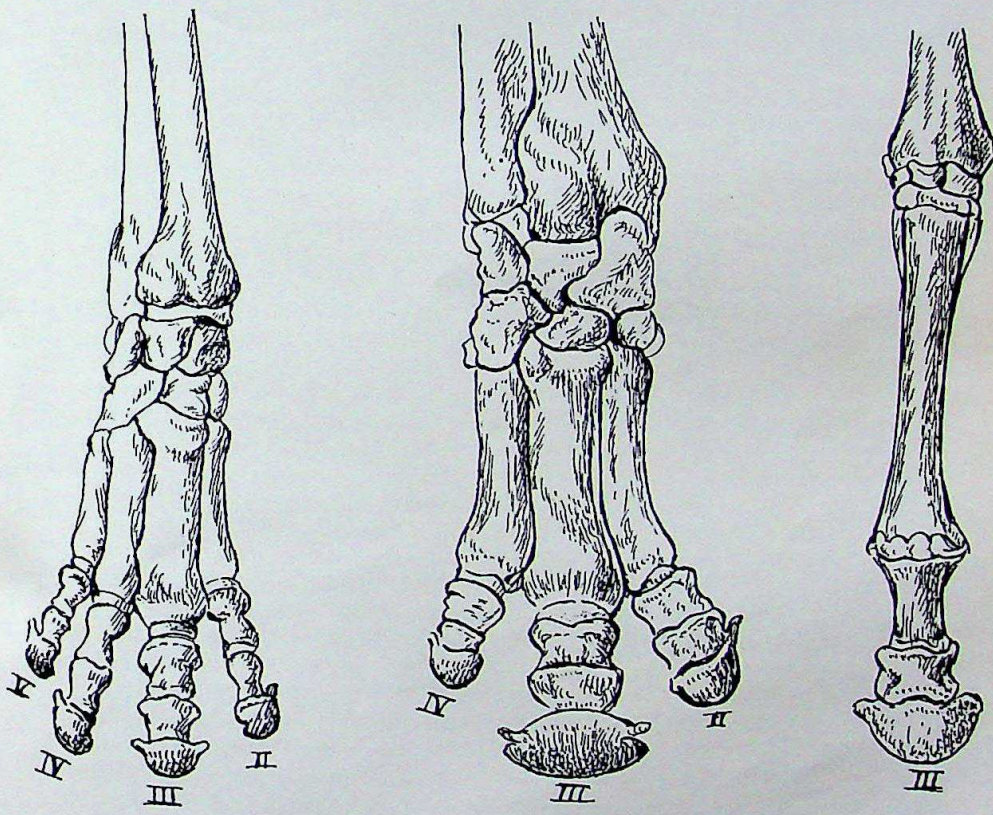

TAPIR. RHINOCEROS. HORSE.

The bones of the forefoot of the three animals are shown: the Horse with 1 digit, the Rhinoceros with 3 and the Tapir with 4. In all of them the 3rd or middle digit is symmetrical in itself and much more developed than the other digits.

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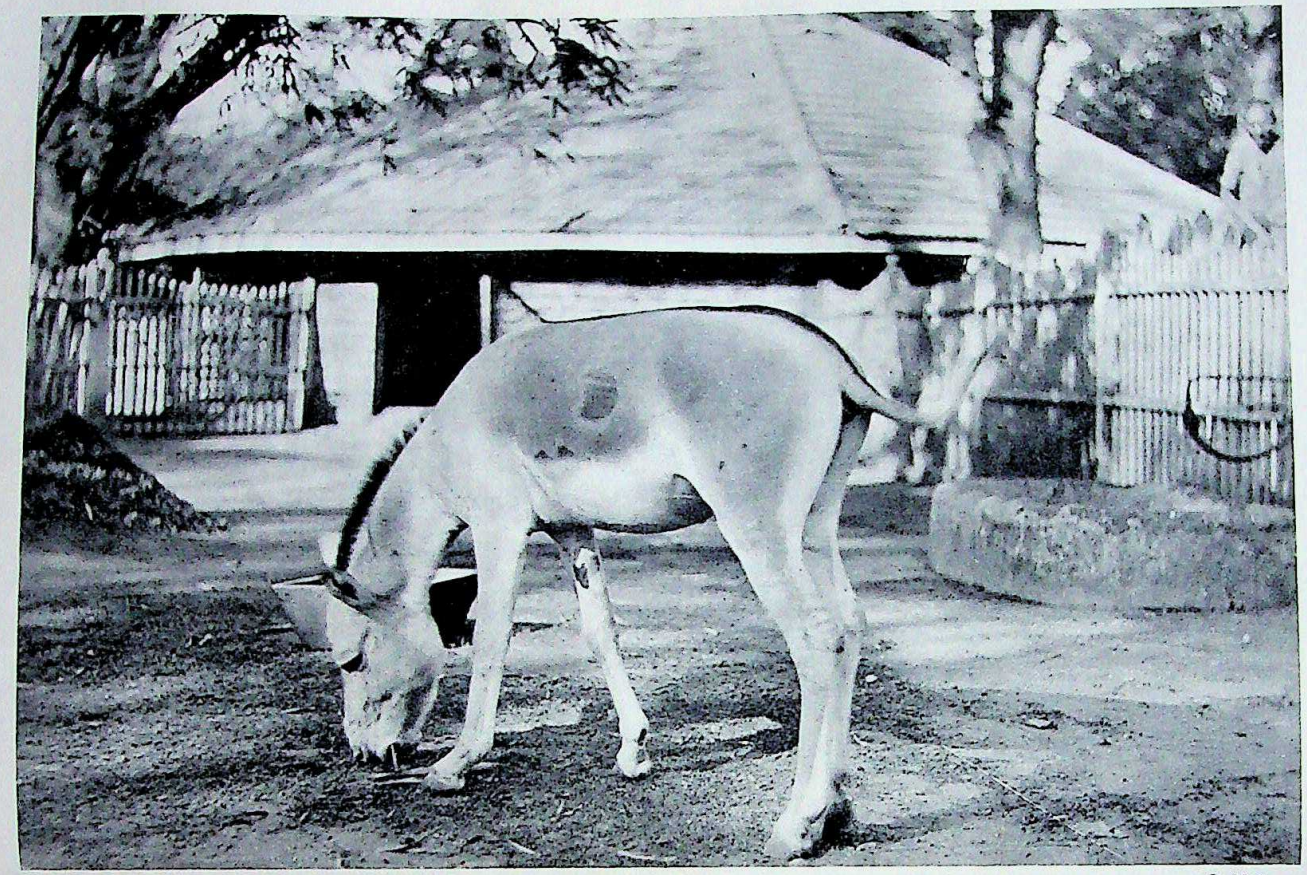

Photo by *C. McCann*

The Indian Wild Ass (*Equus onager indicus*, Pallas).
Height at shoulder 44-48 in.).

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Family I: *EQUIDAE*.

HORSES, ASSES AND ZEBRAS.

The Kiang (*Equus kiang* Moorcroft.).

The Ghor-khar or Indian Wild Ass (*Equus onager indicus* Blyth.).

The Horse tribe includes the Asses and Zebras. In all these animals each foot has a single complete toe encased in a large solid hoof. It is supported by a long bone known as the 'cannon bone'. Small splint bones on each side of the 'cannon' bone represent the vestiges of the second and fourth toes. The cheek teeth are large, quadrangular and complex, the enamel foldings being numerous as compared with the simpler ones of the Rhinoceroses and Tapir.

In the wild state the family is confined to the plains of Asia and Africa. Two species are resident in our area. The Kiang (*Equus kiang*) and the Ghor-khar or Indian Wild Ass (*E. onager indicus*). The Kiang lives in the high open plateaus of Ladak and Tibet. The Indian Wild Ass is found in Baluchistan, Cutch and in parts of the desert zone of North-Western India. Both the Kiang and the Ghor-khar are more closely allied to the Horse than to the true wild asses of North Africa. Like all Wild Asses, they have short upright manes. Those curious callosities seen on the inside of the legs of the horse, the purpose of which is unknown are absent in the ass. The Kiang is distinguished by its large horse-like hoofs. The hoofs of the Ghor-khar are smaller and more ass-like. A Kiang's ears are comparatively short. The coat is reddish in summer, tawny grey, woolly and dense in winter. Like all wild asses it has a dark brown stripe along the back from the nape to the tail. A Kiang stands about 51-52 in. at the shoulder.

Wild asses are usually shy and difficult to approach but the Kiang is one of the most inquisitive of animals and will frequently approach within 50 yards or so of any strange object.

The Ghor-khar which is the eastern race of the Persian Wild Ass is a smaller animal than the Kiang. It is about 46 in. high at the shoulder. In summer its coat is sandy, in winter, grey.

Wild asses are remarkable for their fleetness and their capacity of getting over rough and stony ground at a great pace. As a rule these animals inhabit desert plains or as in the case of the Kiang open rolling tablelands where both desert and arctic conditions prevail.

They associate in small parties of 4 or 5. Sometimes these parties unite and form large herds. During the foaling time the Kiang mares collect in certain favoured areas while the stallions are scattered about either solitary or in twos and threes.

In the plains to the west of the Indus, Wild Asses are found wandering about for the greater part of the year but in the hot weather when the grass withers and water is scarce they migrate to the hills. The mares are said to drop their foals in July and August.

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Family 11: *RHINOCEROTIDAE* RHINOCEROSES.

The various species of Rhinoceroses, all now confined to the Old World, differ remarkably from one another in structure. As a result of migrations during past epochs into different habitats and climates, into new feeding grounds to which they became adapted, the various species appear to have become distinct at a very early period of their history.

A comparison of the remains of numerous extinct forms with those now living indicates 7 distinct lines of descent and evolution from which lesser branches were given off. Though these animals are externally similar they are thus really very far apart both in history and anatomy: even the two living African Rhinoceroses probably separated from each other and became distinct species a million years ago.

Three species of Rhinoceros are found within our limits. The Great One-horned Rhinoceros (*Rhinoceros indicus*) and its relative, the Smaller One-horned or Javan Rhinoceros (*Rhinoceros sondaicus*) have an obscure genealogical history. No representatives of these true and typical Rhinoceroses have been discovered anywhere but in South-Eastern Asia. Their remains are not found in the more ancient Sivalik beds. But they appear with relative suddenness in the uppermost and more recent beds in the form of two species known as the Sivalik Rhinoceros (*R. sivalensis*) and *R. palaeindicus* the ancient Rhinoceros of India.

The Asiatic two-horned Rhinoceros (*R. sumatrensis*) was on the other hand widely distributed in the past. It was quite abundant in the Sivalik hills in Pliocene times. It was a geological period when these animals, favoured by a genial climate, inhabited a broad forest belt which stretched from the east coast of England southwards and eastward across Southern France and North Italy to India.

All the living Rhinoceroses are included in a single genus. Their massive build, the thickness and solidity of their bones, their short stumpy legs each furnished with three toes are some of the family characters. The skin in all the living forms is either thinly clad with hair or naked and in all the Indian species the heavy hide in places is thrown into deep folds. The nasal bones are enlarged to serve as a support for a single or double horns. When two horns are present they are situated one behind the other in the middle line of the snout. The horn is formed of a closely matted mass of horny fibre issuing from the skin. It has no connection with the skull, although a supporting boss of bone in the skull may serve as its foundation.

The horns grow throughout life and if lost are reproduced.

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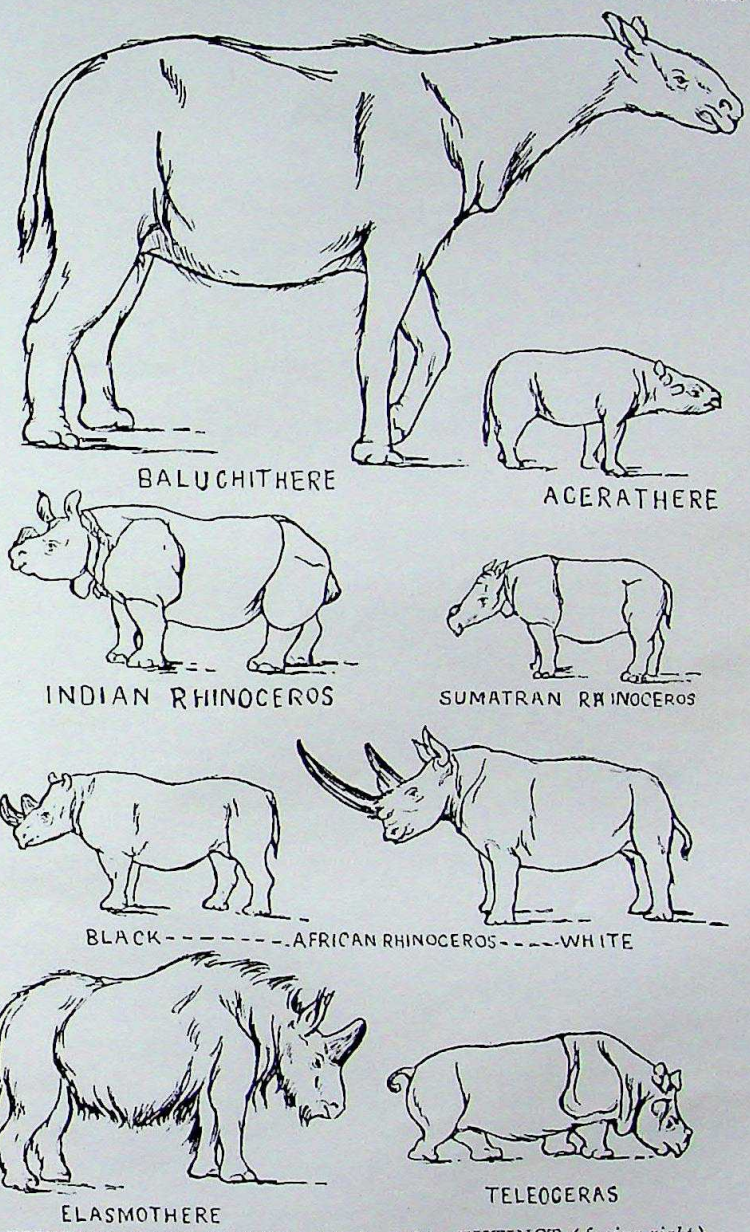

RHINOCEROSES LIVING: (*facing left*); EXTINCT (*facing right*).

The Baluchithere, an aberrant form of Rhinoceros, whose remains were discovered in the Butgi Hills, Eastern Baluchistan is believed to have been 13 ft. high at the withers. It towers above all its relatives. (*Reproduced from Natural History, Vol. XXIII, No. 3*).

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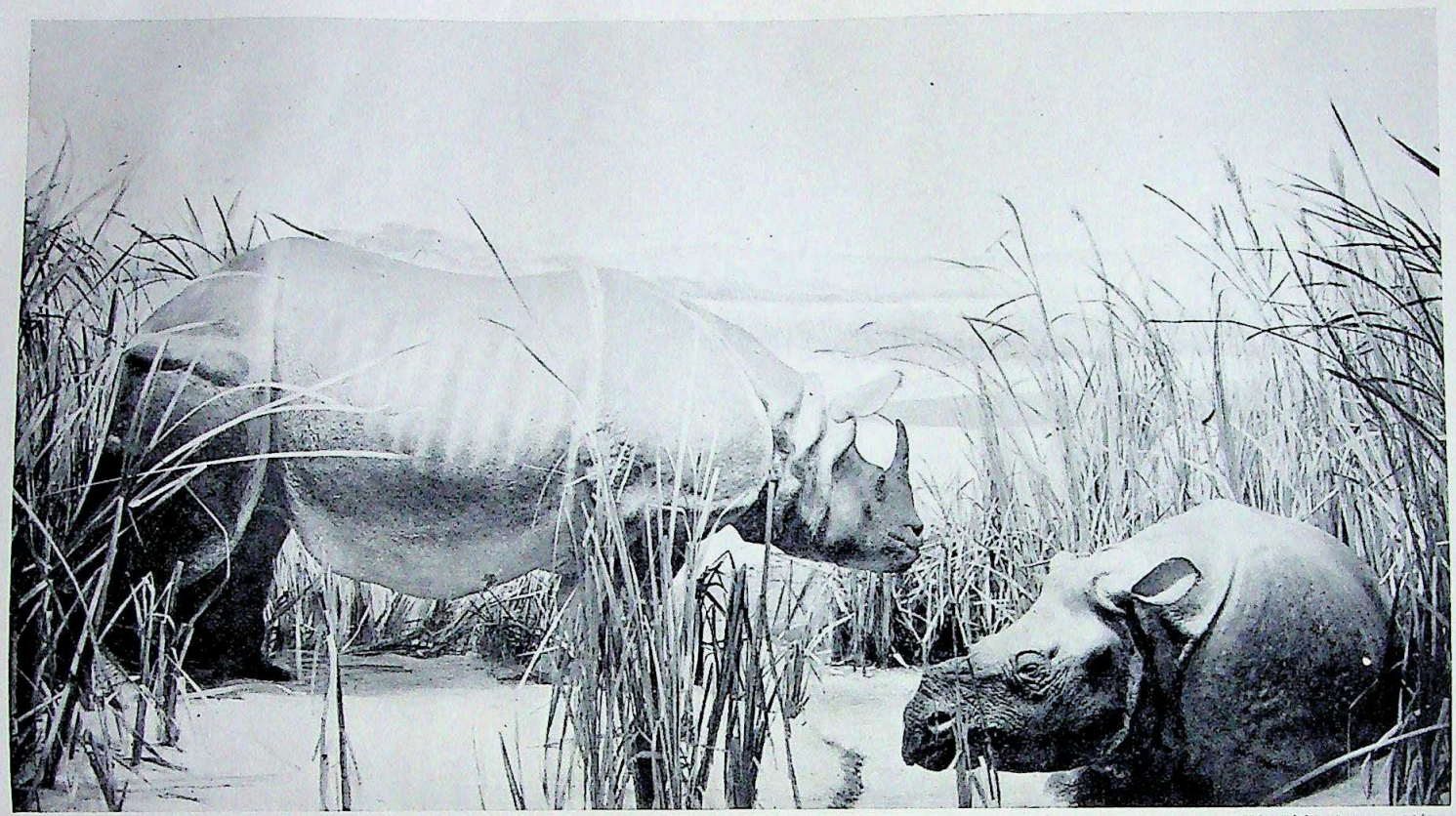

By Courtesy of *The Field Museum, Chicago.*

The Great One-horned Rhinoceros (*Rhinoceros unicornis* L.).
(*Height at shoulder 60-69 in.*).

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THE GREAT ONE-HORNED RHINOCEROS (*RHINOCEROS UNICORNIS* L.).

The Great Indian Rhinoceros, probably the largest of all living Rhinoceroses may reach over 6 ft. at the shoulder.

The average height of a well-grown animal is about 5 ft. 8 in. with a girth of 11 ft. behind the shoulder. The skin of this massive creature is divided into great shields by heavy folds before and behind the shoulder and in front of the thighs. In this Rhinoceros the folding of the skin in front of the shoulders is not continued right across the back. The skin on the flanks, shoulders and hind quarters, is covered with a mass of rounded tubercles. With his grotesque shape, long boat-shaped head, his folds of armour, his scaly hide he looks like a monster of some bygone age. The horns of the Indian Rhinoceros never compare with those of the African. The record from Assam measures 24 in. 15-16 in. is a good average length.

The males may be recognised from the females by a shorter and thicker horn blunted by frequent combats. The female's horn is sharper and longer. Though it prefers swamp and grass the Great Indian Rhinoceros is also found in wood jungle up ravines and low hills.

The animal is solitary as a rule though several may occupy the same patch of jungle. Along the numerous rivers which flow through the jungles of the Nepal Terai the rhino has particular places for dropping its excreta. Mounds so accumulate in places. In approaching these spots a rhinoceros walks backwards and falls an easy victim to poachers. Breeding takes place at all times of the year. The period of gestation is given as 17 to 18 months. In Nepal it is generally believed to be one year. A fully developed calf taken from the uterus measured 4 ft. 1 in. and scaled 120 lbs.

The food consists chiefly of grass. In Nepal during the rains Rhinoceros frequently enter cultivation. Many legends and beliefs are attached to this animal. In Europe, during the Middle Ages its horn was generally believed to have peculiar medicinal virtues.

In Nepal the flesh and the blood of the Rhinoceros is considered highly acceptable to the *Manes*. High caste Hindus and most Gurkhas offer libation of the animal's blood after entering its disembowelled body. On ordinary *Sradh* days the libation of water and milk is poured from a cup carved from its horn. The urine is considered antiseptic and is hung in a vessel at the principal door as a charm against ghosts, evil spirits and diseases. These beliefs connected with the Rhinoceros are prevalent in varying form in Burma, Siam and China. They set a great value upon the animal and provide the main reason for its persecution. In Nepal, the Indian Rhinoceros is found only in the country to the east of the Gandak river known as Chitawan where strict preservation by the Nepal Government has saved it from extinction. In parts of Assam, where it is still found, strict preservation has temporarily saved it from extermination.

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THE SMALLER ONE-HORNED OR JAVAN RHINOCEROS (*RHINOCEROS SONDAICUS* CUV.).

The Javan Rhinoceros is a close relative of the Great One-horned Rhinoceros. Though smaller, it is still a very bulky animal. Old bulls measure about 5 ft. 10 in. at the shoulder. The single horn is never very long. $10\frac{3}{4}$ in. is the record. The horn does not appear to be developed in females or, if developed at all, it is only a low boss. In distinction to its relative, the fold of skin on the shoulders is continued across the back. The hide is marked all over with a mosaic like pattern.

The Smaller One-horned Rhinoceros was once believed to range from Bengal and Assam through Burma and the Malay Peninsula to Sumatra. As far as can be ascertained its range is now limited to the Malay Peninsula and Java where a few still exist under protection. In earlier works on Burma, it is mentioned as having been once abundant in the forested banks of large rivers in the district of Tenasserim. Recent attempts to discover whether this rhinoceros still exists in Burma have failed and it is doubted whether there are more than half a dozen specimens and it is doubtful whether these will survive without adequate measures for their protection. Though it occurred in the Bengal Duars in former years, its presence in this area at the present time requires verification.

The Smaller One-horned Rhinoceros is more an inhabitant of tree forest than of grass land. Its low crowned grinding teeth indicate that it is a browser, indulging less in grazing than the Indian Rhinoceros, whose armoury of high crowned grinding teeth are peculiarly adapted to the mastication of grass. Its usual habitat is hill country where it has been found at elevations as high as 7,000 ft. above sea level.

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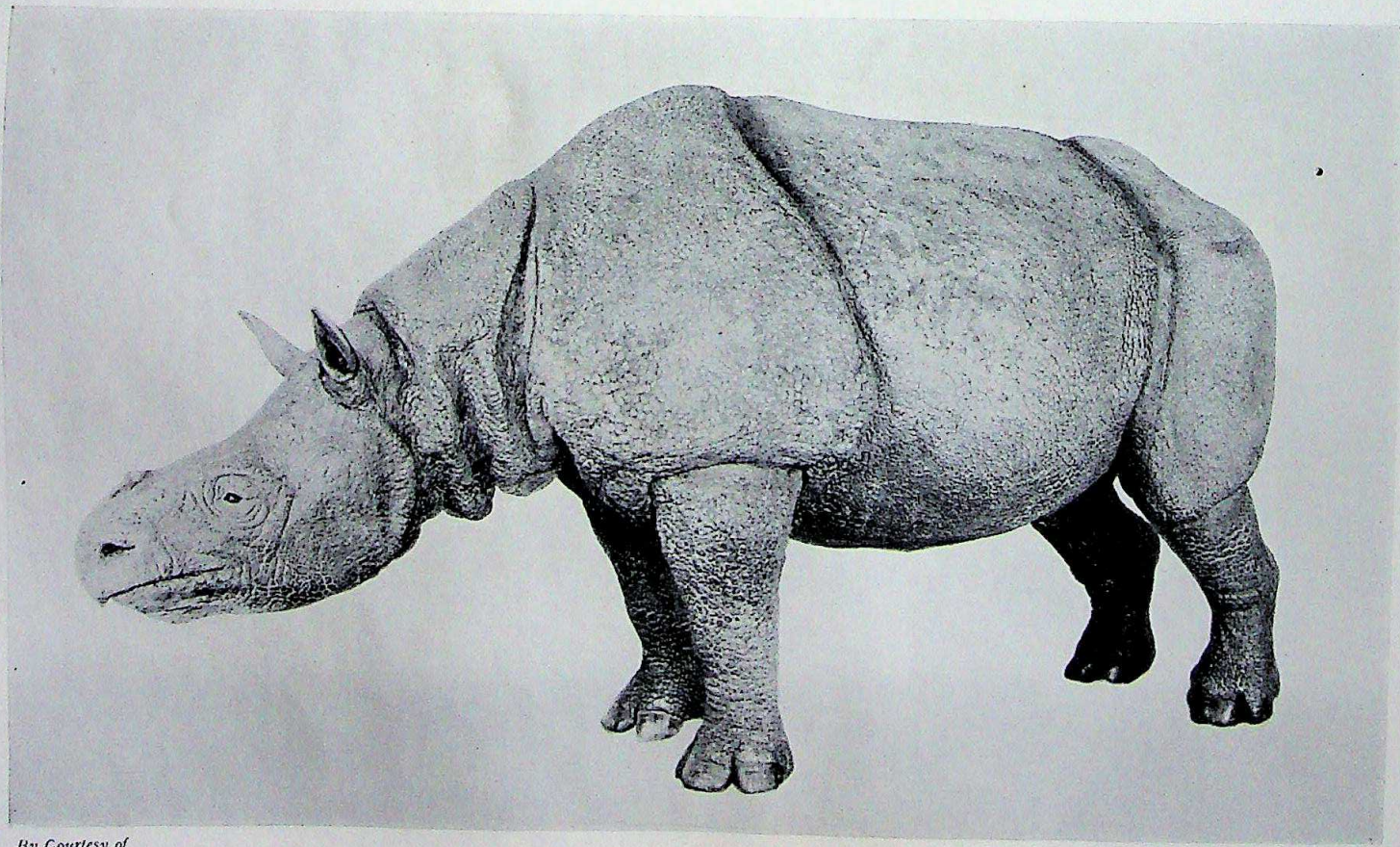

By Courtesy of *The Brit Mus Nat. Hist.*).

The Smaller One-horned Rhinoceros (*Rhinoceros sondaicus* Cuv.)
(*Height at shoulder 70 in.*).

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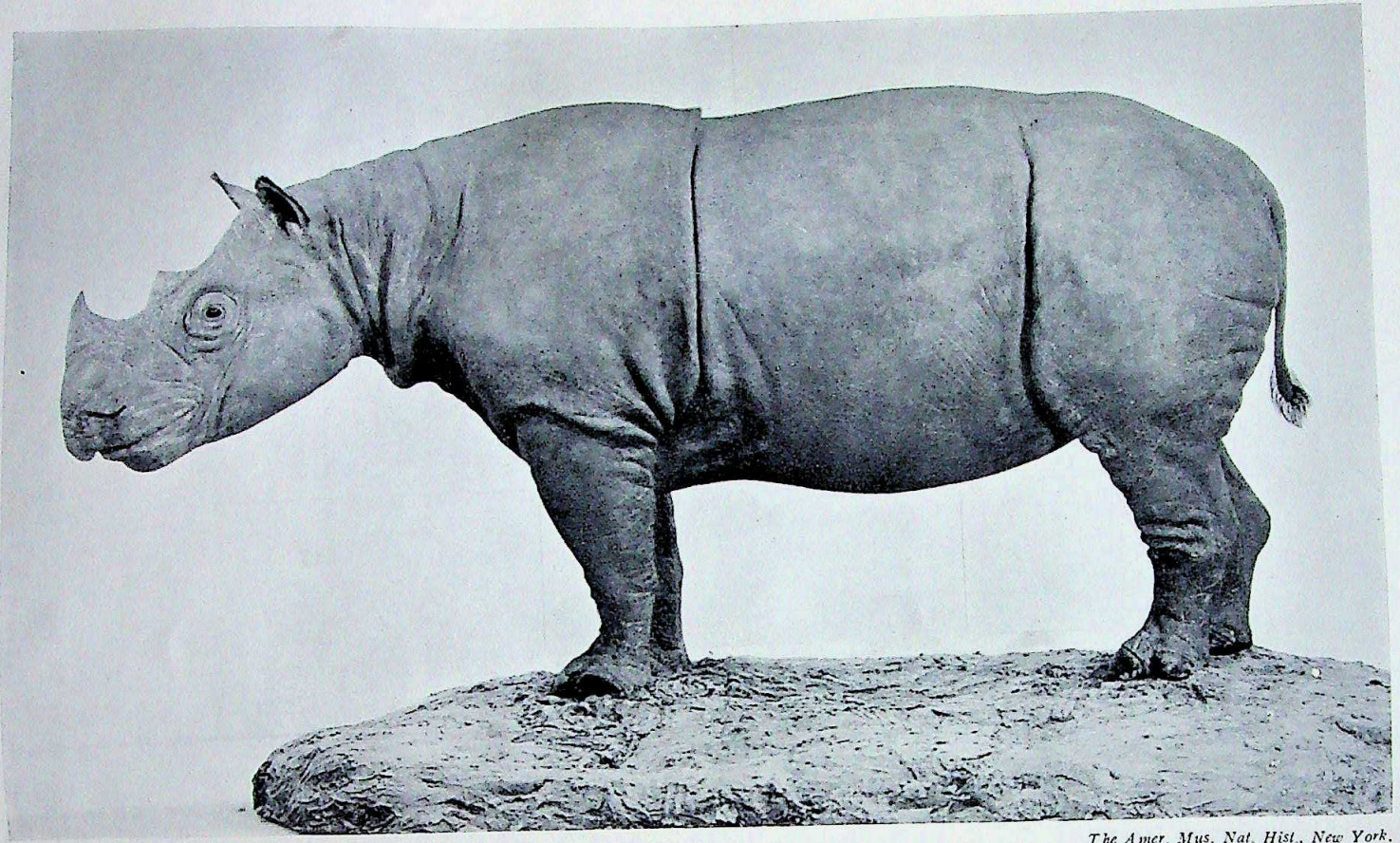

The Amer. Mus. Nat. Hist., New York.

By Courtesy of

The Sumatran Two-horned Rhinoceros (*Rhinoceros sumatrensis* Cuv.).
(*Height at shoulder about 52 in.*).

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THE SUMATRAN TWO-HORNED RHINOCEROS (*RHINOCEROS SUMATRENSIS* CUV.).

The Sumatran Rhinoceros differs from the two other Asiatic Rhinoceroses in possessing two horns. On this account it is considered to represent a distinct sub-generic group (*Diocerhinus*). It is further distinguished by having a single pair of lower front teeth instead of two pairs as in the Indian and Javan animals.

The Two-horned Rhinoceros, like the Lesser One-horned species has a preference for forested hill tracts where it wanders up to considerable elevations. A sufficiency of shade and a good supply of water are essential to its habitat. A pair will frequent a given area for a time and then move off, their movements being affected by the water supply. They enter streams by night and also during the hot hours of the day. In suitable spots there are regular wallows or 'mud baths' in which the huge creatures roll much as buffaloes and pigs do. As a result of this habit their bodies are always well coated with mud. Tracks lead off in all directions from these 'wallows'. They present the appearance of large tunnels hollowed through the dense undergrowth. Unlike the elephant, a rhinoceros does not break through the jungle but burrows his way through the dense tangle. They visit the wallows singly or a bull and a cow may be found together. The night and early morning is spent in wandering about and feeding; the hot hours of the day in rest in some cool and shaded spot. In the cold weather and rains they visit the low country coming down in search of particular foods. They are not grazers but browse on twigs, shoots and are very partial to fallen fruit:—wild mangoes, citrous fruits and figs.

The sense of smell and hearing is acute but the sight is poor. Collections of dung found at particular places reveal a habit similar to that noticed with the Great One-horned Rhinoceros.

Little is known about their breeding habits but it is known that the young remain with the mother to a fairly advanced age.

The Two-horned Rhinoceros was once fairly common throughout Burma—it also occurred in Assam from which province it is now practically exterminated. At the present time a few inhabit the forests of Lower Tenasserim and the hill tracts about Myitkyina, the Arrakan Hills and the Pegu Yomas. A small number are present in the Shive-u-daung Sanctuary in the Mogok division of the Katha District where proper protection may save this species from extinction in Burmese limits.

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Family III: *TAPIRIDAE*: TAPIRS.

THE MALAY TAPIR (*TAPIRUS INDICUS* CUV.).

The third and least specialised family of surviving Odd-toed Ungulates contains a single genus—*Tapirus*, the Tapirs. Tapirs differ little in their anatomy from their fossil ancestors and appear to have retained their primitive character even to our times. In the remote past they probably inhabited, as they do now, the deep recesses of the forest. Such protected environment is never favourable to rapid evolution but rather to persistence of type. We see this exemplified in the Two-horned Rhinoceros, like the Tapir, a creature of dense forest which shows little change in its anatomy as compared with the Two-horned Rhinoceros of past geological epochs.

Tapirs differ from all odd-toed ungulates in having 4 toes on the front feet. Their hind feet as with the Rhinoceros is three-toed. The three large toes of the fore foot correspond to the three middle fingers of the human hand. The little outer toe represents the fifth finger.

The cheek teeth have two simple transverse crests on their crowns, very different from the complex enamel foldings of the teeth of rhinoceroses and horses.

A heavy ungainly body, short stout limbs, a muzzle lengthened to form a short trunk, small eyes, oval ears and stumpy tail, all give the Tapir a peculiarly antedeluvian appearance.

Tapirs once inhabited Europe and from thence they appear to have migrated southwards. One group reached the New World where they still survive in Central and South America and the other passed down into the Malay countries.

The Malay species is very distinct from its American relations. It is larger and has a bi-coloured coat. The head, limbs and front part of the body is brownish black, the rest of the body behind the shoulders is greyish white. The American Tapirs are uniform brown. The young of both animals are striped. The Malay Tapir stands from 3-3½ ft. at the withers and slightly higher at the rump. The species is confined to Sumatra and the Malay Peninsula and only enters our limits in the south of Tenasserim. Here it lives in densest forests and has many of the habits of the rhinoceros browsing on leaves and twigs and visiting wallows. It is a water loving creature and swims and dives well. A pair of Tapir in captivity displayed a habit of carefully concealing their droppings. Copulation took place in the water. A single young was produced. The period of gestation was 9 months.

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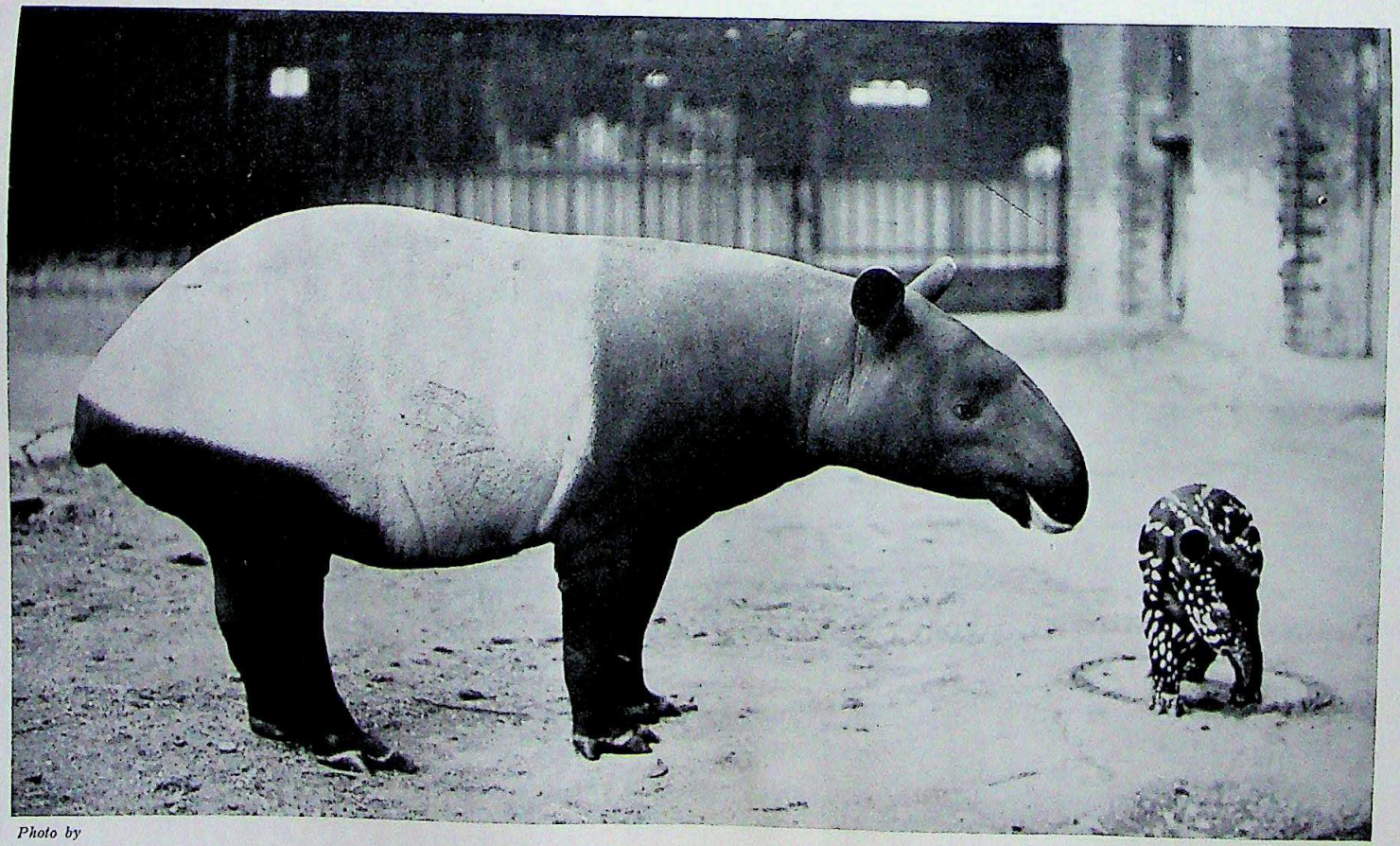

Photo by *W. S. Berridge.*

The Malay Tapir and young (*Tapirus indicus* Cuv.).
Height at shoulder 36-42 in.).

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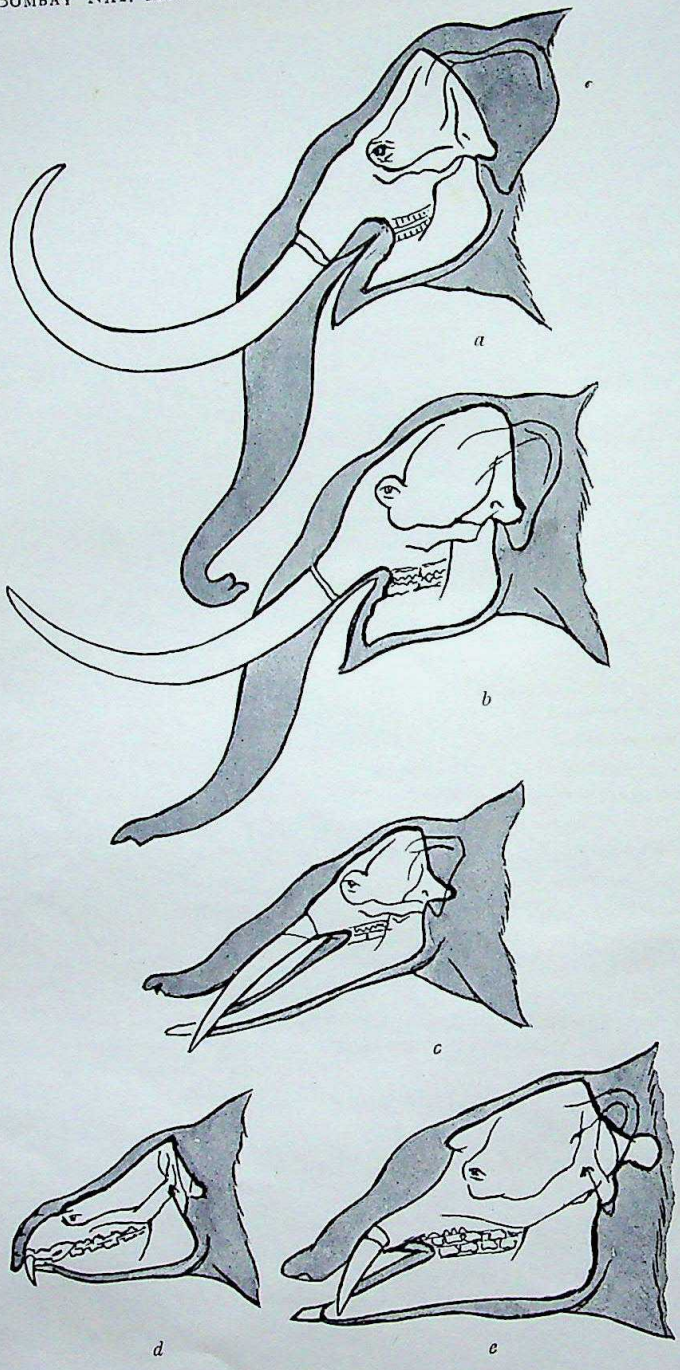

Evolutionary changes of Proboscidea. Based on restorations modelled by R. S. Lull.

a. *Elephas columbi* ; b. *Mammut americanum* ;
c. *Tetrabelodon angustidens* ; d. *Moeritherium* ;
e. *Palaeomastodon*. (*Reproduced from Ann. Report, Smithsonian Institution, 1909*).

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PROBOSCIDEA: Elephants.

The proboscis or trunk of the elephant gives the name Proboscidea to this the fourth and last order of Ungulates. There are but two species of elephants in existence—the Indian and the African. They are the sole survivors of a great assemblage of species which once inhabited the earth. No fewer than seven species of elephants and 8 different Mastodons are known to have existed in India during remote geological periods.

With its pendant trunk, its curious dentition, and its great size the elephant presents distinctive characters which differentiate them from all other mammals. However remarkable these characters may be, they are the ultimate results of a gradual deviation from a standard type of mammal—a hairy creature of no great size walking on the soles of its five-toed feet and carrying in its jaws the typical complement and number of incissor, canine and molar teeth. A comparison of existing and extinct forms of elephants and their allies has helped to indicate the great physical changes which the race has undergone during the long ages of its history. Changes which have been brought about largely by migrations to new countries and the new condition of life which they imposed. These migrations were impelled not only by the natural urge of the creature to extend its territory but also by actual changes in the earth's surface which bringing about a difference in climate and vegetation forced the ancestral forms to migrate into areas where conditions of life were more congenial. The physical modifications which elephants display are seen firstly in an increase in size. This necessitated the development of pillar-like limbs to support the enormous weight of the body which again implied the straightening of the limb bones and a change in the angle of their articulation. The foot itself changed its posture from the primitive plantigrade position. The heel and ankle bones were elevated above the ground and a thick pad of gristle developed beneath each foot and so formed a cushion to receive its share of the weight. The toes were embedded in the common mass of the cylindrical foot and encased in a common skin. Their position is indicated externally by broad flat nails which may be fewer than the number of toes. Thus, the limb bones gradually developed into vertical shafts through which the weight of the body was transmitted.

The shortness of the neck and the height of the head from the ground necessitated the development of a proboscis or trunk—a combined and lengthened nose and upper lip—as a device for securing food and water. Its development was accompanied by marked changes in the character and form of the skull. The skull of an elephant shows no 'snout'. The bony part of the face is almost straight. But it would appear that the ancestral elephants had a longer face—a prolonged bony snout more in conformity with the standard mammal skull. This is seen to some extent in the skull of the American Mastodon and to a more remarkable degree in a yet more ancient form of Mastodon—the *Tetrabelodon*. The creature had an extraordinary lengthened lower jaw furnished with

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two horizontal tusks. These tusks were additional to a downward bent pair in the upper jaw. Its trunk must have rested horizontally on its lower jaw between the tusks. It was not a pendant trunk but an elongated upper lip. It is believed that an elephant's trunk originated in this way. Firstly by the great elongation of the lower jaw producing a corresponding lengthening of the proboscis to reach to the need of the tusks and then by a shrinkage of the lower jaw and the straightening of the bones of the face. The long proboscis was no longer supported by the lower jaw. Gradually dropping as the lower jaw receded, in the course of successive ages, it at last hung down as a pendant trunk.

Other physical changes undergone by elephants are seen in increase in the size and complexity of the teeth, their consequent diminution in number and the development of a peculiar method of tooth succession. All the canine teeth have been lost and all the incisors, except the second pair in the upper jaw. These have developed into tusks. As to the grinding teeth an elephant develops 6 molars in each jaw during its life time. But the jaws are so short and the grinders so large that there is never room for more than two—one entirely and the other partly exposed above the gums. The new tooth forms in the rear of the jaw. Pushing forward it gradually replaces the preceding tooth which, as it wears away, is crowded out of the jaw. The first milk molar appears at the age of two weeks, it is shed at the age of 2 years, the second is shed at the age of 6, the third at 9, the fourth (or first adult tooth) between the 20th and 25th year, the fifth at 60 and the sixth lasts for the remainder of the creature's life.

Each molar is larger than the one which preceded it. Its structure has no parallel in the teeth of other animals. It is made up of a series of plates each composed of a flattened mass of dentine invested by a layer of enamel, the whole bound together in a solid mass by cement. As the dentine wears the harder enamel appears in a series of transverse ridges across the crown of the molar. The number of these ridges varies. In the Indian elephant the last or 6th molar may show 27 of these ridges. In the African species the number never exceeds 11. The African elephant is larger than the Indian. It has enormous ears, a hollow back and only three nails on each hind foot. There are 4 in the Indian species. The trunk ends in two equal sized 'lips'. The Indian elephant has but one.

The *Proboscidea* form a single family the *Elephantidae* which includes but one living genus.

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Photo by *W. S. Thom.*

The Indian Elephant (*Elephas maximus indicus* L.).

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THE INDIAN ELEPHANT (*ELEPHAS MAXIMUS INDICUS*).

The Indian elephant rarely exceed 10 ft. 6 in. at the shoulder. The average height of an adult male is 9 ft. The female is a foot lower. Twice the circumference of an elephant's fore foot gives a fair indication of its height. The rule does not apply always in the case of young and growing animals.

Generally only the males have large tusks. The tusks of females scarcely protrude or perhaps protrude a few inches. In some males the tusks are no longer than in females. Many of these tuskless males or *maknas* are very large in build with extraordinarily well developed trunks. The contour of the tusks varies. In some elephants they are wide spread and curved, in others straight and pointed downwards. A pair in the Royal Museum at Siam taped 9 ft. 10½ in. A pair in the possession of H.M. the King measures 8 ft. 9 in. and 8 ft. 6½ in. and weighs 160 and 161 lbs. respectively. The elephants found in Ceylon are regarded as a separate race (*E. maximus zeylanicus*). The males carry quite normal tusks. The females are tuskless. A few big tuskers shot in Ceylon are believed to be the descendants of elephants introduced from India.

The Indian Elephant has normally five nails on its fore foot and four on its hind. The outside nails are comparatively small and crinkled and their impression is only traceable in very wet soil. Ordinarily the imprint of at most three nails is to be seen and that only on soft ground. The colour of the elephant is greyish black. The chest, forehead and ears are often covered with flesh coloured spots.

An elephant usually moves at a walking pace, when alarmed or annoyed it breaks into a shuffling run. The huge creature can attain a wonderful speed and when 'all out' may travel at quite 20 miles an hour. Despite its bulk the elephant is wonderfully active going up and down steep hill sides with ease. It is an excellent swimmer and in deep water swims with practically the whole body except part of the head and trunk submerged.

Elephants chiefly frequent districts covered with tall forests where the ground is hilly or undulating and where bamboos grow in profusion. They are extremely adaptable and will live in steamy humid jungle or in cool elevated forests. In Burma they wander at all seasons of the year into bamboo forest at a height of 10,000 ft. while in Sikkim, their tracks have been seen in the snow 12,000 ft. above sea level. In the dry season the herds generally keep to the denser forests but during the rains come out into open glades and frequently enter cultivation. Individuals of various sizes and ages associate in herds which may vary from 5 to 60 or more animals. Herds are believed to be composed of single families. Different herds do not mix but stray females and young males may migrate from one herd into another. When fodder is scarce, the larger herds break up into small parties, which reunite when conditions are favourable. The big tuskers are usually seen feeding at some distance from the main herd. The bulls when they arrive at a certain age, live as solitaries or, two males of equal age may associate together. A solitary bull will graze with a herd when it happens to be in the same patch of jungle

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and will seek the herd when the urge to mate is on it and desert it again when its desire is appeased. When travelling elephants move in single file, the tuskers generally bringing up the rear. The leader of a herd is invariably an old female. Herds travel to and from their feeding grounds by well worn paths, wandering from them when the terrain is favourable but returning to these fixed paths, which generally follow the easiest and straightest line across the country and represent the accumulated wisdom of generations of travelling elephants. When undisturbed, the herd pursues a regular and ordered routine, drinking and feeding in accustomed places and lying up to rest in its usual retreat. They sleep during the hot hours of the day, being intolerant of the sun, feed early in the morning and evening and come out after nightfall to feed in open forest or to raid crops; retiring to sleep after midnight. An elephant rests standing or stretched out on its side. The food consists of various kinds of grasses and leaves, stems and leaves of wild bamboos and plantains, all species of crops and the bark of particular kinds of trees. A full grown elephant will eat from 600-700 lbs. of green fodder in a day.

Male elephants, very rarely females, both tame and wild, on attaining maturity are subject to peculiar periodical paroxysms of excitement known as '*musth*'. *Musth* seems to have some connection with the sexual functions. It is probably analogous to the 'rut' in deer. It occurs most frequently during the cold season and may perhaps be due to ungratified sexual desire. In some cases this is not always so since the society of a female will by no means quell or pacify the animal. At other times an elephant in musth will seek a mate.

The exact breeding season is uncertain but as most of the young are dropped in the late autumn and the period of gestation lasts about 20 months it is probable that the main breeding season is during the hot weather and at the commencement of the rains. One calf is only born at a time though, in rare instances twins and once, even triplets have been recorded. The mother of a young calf is invariably assisted in caring for her young by another female who takes on the duties of a guardian and is as assiduous in her care of the calf as its parent. A new born calf will walk a few hours after birth. In height it averages about 2 ft. 10 in. It suckles with its mouth and when alarmed takes refuge under its mother's body.

Elephants have a very poor sight, the sense of smell and hearing is highly developed, more so than in most animals. Much mystery is attached to the deaths of elephants. They are reputed to seek out some solitary and secluded spot to which they retreat when they feel their powers failing and death approaching. The legend is widespread, though it remains to be substantiated. The fact that dead elephants are seldom found may be explained firstly by the infrequency with which deaths must occur among such long lived animals and secondly by the rapidity with which decomposition in a tropical climate will remove all traces of the carcase. There are some instances on record where other elephants have attempted to move or have actually moved the dead body of a companion.

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THE PRESERVATION OF WILD LIFE IN INDIA.

No. 3. *ASSAM.*

BY

A. J. W. MILROY.

(*Conservator of Forests, Assam*).

The question of affording adequate protection to game in Assam is a difficult one that we cannot expect will receive much local attention just now with so many important political changes staged for the immediate future, but in view of the imminence of these inevitable changes in administration it might be undesirable to postpone any longer the consideration of what system of preserving the fauna, whether the present one or something on different lines, will be most likely to survive the introduction of provincial autonomy.

Up to thirty years ago there were still very extensive unoccupied tracts in the Province, the first to disturb them being Gurkhali buffalo-keepers who began then to invade Assam with their herds, to be followed by ever-increasing hordes of immigrants, after the Brahmaputra Valley had become linked to Bengal by the railway.

Rules regarding close seasons had been framed at an early date for the Reserve Forests in conformity with practice in other parts of India, but game remained entirely unprotected in the waste lands known as Unclassed State Forests, until about 1910 when close seasons were introduced following a letter to *The Times* by Sir Harry Johnston on the indifference shown by Provincial Governments in India to the fate of their wild animals; but as no fees have ever been charged for shooting in the Unclassed Forests, there have been no funds for the maintenance of a special patrolling or protective staff, and the protection afforded by the rules alone has consequently been very meagre.

Types of Game Country.

Enormous areas of grass and reeds used to extend from the banks of the Brahmaputra towards the hills which enclose the valley on both sides, and it was here that most game used always to be found—rhinoceros, and swamp deer in the low-lying places, elephants, bison, and other deer nearer the hills—but these are precisely the very localities that attract the buffalo-herdsmen and the settlers, so that a great deal of this type of jungle has now disappeared for ever and it is only a matter of time before the most of the balance goes too. In these circumstances the policy adopted a few years ago of issuing gun-licences almost indiscriminately has only accelerated what was bound eventually to take place, and what has already occurred in all countries suffering from, or

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blessed (as the less far-sighted hold) with, an increasing human population.

Most of the former great shooting grounds are thus being occupied exclusively by Man and nothing can be done in them for wild animals. There remain for consideration the Reserve Forests, which have been taken up mostly for timber, but which include as Game Sanctuaries two important grassy areas.

Dense, evergreen forests contain comparatively little fodder suitable for game animals, which prefer the more open and the deciduous tree forests, but everywhere in Reserves reasonable game preservation should be looked for, seeing that the sale of shooting permits is a possible source of revenue, that rules exist for the benefit of the various species of animals, and that a Forest Staff is provided by Government to uphold these and other Forest Laws. It must be confessed, however, that in Assam just as in Burma, judging from some recent Annual Forest Administration Reports from that Province, game preservation is largely a matter of individual whim, and that encouraging results obtained by one Divisional Forest Officer are only too often dissipated during the regime of a successor, who is indifferent to this side of his multifarious duties.

The present Government cannot be accused of lack of keenness. Three years ago, a British Officer and a Company of Assam Rifles were detailed to spend six weeks touring a district where the inhabitants had got out of hand and were poaching in the Monas Game Sanctuary on a commercial scale, while at the present moment an energetic Assistant Conservator is on special duty at the head of an anti-poaching campaign that is doing some very good work indeed. The Assam Legislative Council have recently declared Rhinoceros horns to be forest produce wherever found, it has become much easier to deal into the trade in these, as horns are now liable to seizure unless their possession can be satisfactorily accounted for. No help from the centre, however, can make up for lack of interest on the part of the officers on the spot, though an enthusiastic Conservator can do much to overcome apathy, thanks to the tradition of loyalty in the Forest Service, but to be really effective he must possess both the time and the inclination to tour 'off the map' and away from the usual comfortable, stereotyped marching routes.

At the worst a certain amount of game of most sorts will linger on in the larger Reserves for some time yet, but not in the smaller ones which can be easily raided, and from which animals are always straying into settled lands bristling with guns: at the best, if the Forest Department does not depart from the policy of recent years as regards Forest Villages and as regards demanding the co-operation in these matters of its subordinates, quite a fair number (in some places sufficient to allow of restricted shikar) of the more interesting species will survive in suitable localities within the forest boundaries.

Increased pressure on the outside land being likely to lead to a demand for catastrophic disforestation of cultivable areas inside the Reserves, it would appear to be advisable to proceed cautious-

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ly, when and where needs be, with the formation of Forest Villages, especially of non-resident villages which luckily for wild animals are preferable from the utilitarian point of view, as they do not waste good forest land in hamlet sites and cattle-grazing grounds. Forest Officers in Assam will always be dependent on elephants for getting really inside their forests, and this again is lucky for the game, because it is essential permanently to set aside from settlement adequate and inviolable elephant grazing grounds while there is yet time, for want of which provident measure other Provinces have had to plant fodder at considerable expense for their Government elephants.

It would be illogical to allow villagers to grow crops in a forest and then to withhold from them the means of guarding the same, but the practice lately enforced of calling in guns for safe custody after the harvest is over is only logical and reasonable, and prevents the villagers from degenerating into professional poachers, as some of them have become in the past.

It had been intended, in order to obtain complete control, to acquire on behalf of Government all the guns owned by Forest Villagers for temporary issue at the right time, together with any others that might be necessary, but this measure has had to be postponed until funds become available again.

Game Sanctuaries.

The two Game Sanctuaries of which mention has been made are situated, the Monas towards the north-west on the Bhutan frontier and the Kazirunga in the centre of the valley on the south bank of the Brahmaputra. Both areas were originally selected for the Great One-horned Rhinoceros (*R. unicornis*) they contained, and a very fine stock of these animals was raised as the result of the protection afforded. Kazirunga, the more low-lying, is particularly suited for buffalo too, the Monas for bison along the Bhutan boundary.

The rhinoceros, our most important animal from the natural history point of view, is a difficult species to preserve even though its destruction is forbidden by law, because all parts of its body may be eaten even by Brahmins and because its horn is reputed throughout the East to possess aphrodisiac properties, while it lays itself open to easy slaughter by its habit of depositing dung on the same heap day after day. The demand for rhinoceros' horns has always been considerable in India, but of recent years China has also been in the market, consequent on the practical extermination of *R. sondaicus* in Lower Burma, Tenasserim, etc., with the result that a horn is now worth just about half its weight in gold. The prospect of a lucrative business led to an organization being formed for passing on rhinoceros' horns and elephant tusks to Calcutta, and the disturbed political conditions provided the virile Boro tribes (Meches and Kacharies) living near the Monas with the opportunity to take up poaching on a large scale.

The operations of the financiers in the background were checked for the time being; the advent of the Assam Rifles restored order;

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additional game-watchers were engaged, and an Assistant Conservator was placed in charge of the Sanctuary to carry on the good work, but in view of what has happened in Burma, despite the best efforts of the authorities there, one cannot be confident that the fight we are putting up will not prove in the end to be a losing one if we merely continue on present lines.

A fundamental obstacle to success lies in the difficulty of identifying poachers unless these are actually caught in *flagrante delicto*, and this must always be a rare occurrence when members of a gang have only to separate and run a few yards into the high grass to evade capture.

Both Sanctuaries are at present inaccessible for want of roads and camping huts except to those who can travel light, such as poachers and game-watchers, and to those who can command the use of elephants, such as Forest Officers and a few planters. It was pointed out some years ago that this being so it would be quite possible, without the outside world being any the wiser at the time, for a dishonest subordinate in immediate charge of a Sanctuary to sell all the game while his Forest Officer, absorbed in other duties, was earning credit for the good work he might be doing elsewhere in the division. The loss would obviously be irreparable, and it was suggested that in these circumstances the western and eastern portions of the Monas Sanctuary, which with adjacent Reserves contains an effective area of about 150 sq. miles, should be opened to shooting under very strict supervision, the bag being limited (wounded to count as killed) and very high fees being charged, while the central part was preserved inviolate for the benefit of those interested in studying or photographing wild animals. The Sanctuary is only 10 miles north of the Amingaon branch of the Eastern Bengal Railway, and the interior could very cheaply be made accessible to lorries and cars running up from the station by constructing a few cold weather roads in flat country; the whole journey from Calcutta would take less than twenty-four hours of comfortable travel.

It was felt that in this way a healthy publicity would be ensured, because anyone coming up to shoot or to photograph would have plenty to say if game was found to be very scarce, also that the Sanctuary would be put on a paying basis, for whether the East actually is or is not less materialistic than the West, it is certain that no Province will be able to afford idealistic Finance Ministers, and finally it was felt that overstocking of the ground could in this way be guarded against.

It is permissible to believe that the Sanctuaries might have some chance of survival if they could be made more or less self-supporting, but precious little otherwise, and the question is one on which, we may feel sure, advice from the Society from the depths of its experience would not be resented. The Assam of the future may very well be proud to think it is taking its stand by the side of other civilized countries in saving its fauna from extinction, but it is going to be a poor Province, at any rate to start with, and if only some revenue could be expected from shooting permits and from the sale of captured specimens to Zoological Gar-

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dens, there would clearly be less initial hostility for the good cause to face.

Anything in the nature of a Public Park on the lines of the Kruger National Park would be out of the question unless it was under Imperial control because if the Assamese tax payer ever wants anything of this sort, he will certainly demand that all predatory and dangerous animals be removed before he disports himself in it.

Balipara Political Area.

Apart from the two Sanctuaries mentioned previously, the rhino have one remaining refuge, namely, the Balipara Political Area. Here some very valuable protection has been afforded to this animal in one area by a planter who is an enthusiastic game preserver. Efforts should be made now to enlist the sympathies of the authorities who will have to guard the welfare of frontier tracts for many years to come, and who will doubtless welcome more extended interest being taken in a matter that has now become of world-wide importance to naturalists.

The specially favourable factors in the case of the Balipara Political Area are:—

(1) It will permanently remain outside the influence of the new reforms.

(2) It consists very largely of Forest Reserves, which contain a number of rhino haunts, Gohpur, the Diputa, Gabharu, and Sonairupa rivers and, if buffalo-grazing was stopped, the Bor Dikrai.

(3) The tract is under a Political Officer who is provided with summary powers and the means of upholding them.

The possibilities here are obviously great, and the opportunity of achieving something permanent seems too good to be neglected.

Type of Game.

A few particulars regarding some of the species found in Assam are added by way of conclusion:—

Elephant (*E. maximus*). The country available for wild elephants has been much reduced as the result of land being taken up for settlement while the increasing unwillingness on the part of villagers to tolerate damage to crops will prevent any slowing down of catching operations, but elephants will continue to be numerous in several districts for a long time yet. Over 400 were caught three seasons ago by the Forest Department in one area alone, but this was probably the last big Kheddah that the Province will ever see. Casualties used to be heavy during training, but Government took the matter up and has demonstrated that these are unnecessary and that much higher profits follow the adoption of more humane methods. The rumour that a dumpy breed of wild elephant lived on the central ridge of the Garo Hills has been found to be false as regards the existence of herds composed of such animals, but the inquiry showed that exceptionally short-

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legged specimens are to be met with; it is a matter that some local officer might find interesting to pursue further.

One result of the decrease in the number of wild elephants is the inconvenience experienced in getting about Reserves where elephants have become scarce, as their paths are no longer kept open by the passage of herds. The Province of Bihar has always been the best customer for elephants but as it will be out of this market for many years to come, it is not improbable that elephant control measures will have to be undertaken as in Burma.

The Great One-horned Rhinoceros (*R. unicornis*) has been dealt with already at sufficient length.

The Smaller One-horned Rhinoceros (*R. sondaicus*).—It is on record that Messrs. Rowland Ward identified the head and shield from a rhino shot by a Forest Officer in the Bengal Dooars as belonging to this species, and it would be strange if it did not also occur in the contiguous Goalpara Reserves and Monas Sanctuary. Pairs of smaller, less truculent, and definitely less armoured rhino can be put up in the Sanctuary and these, if not cases of *R. unicornis* pairing while still far from mature, must be specimens of *R. sondaicus*.

Investigation into this is most desirable, and perhaps the Society could arrange for it being carried out in the course of time. The Kacharies recognize three varieties of rhino, and though their classification is not made on scientific lines, it does not follow therefrom that it is all moonshine.

The Sumatran Two-horned Rhinoceros (*R. sumatrensis*).—Formerly common in the Luhsai and Manipur Hills and occasionally found in North Cachar, but by now almost hunted to the vanishing point by Lushais and Kukis. The opening up by forest villagers of several big patches of marshy land in the Forest Reserves of South Cachar seriously reduced the number of suitable haunts available for this species. Most of the remaining patches, however, will have to be kept closed to cultivation in order to preserve feeding-grounds for the timber-dragging elephants, and some special steps have already been taken to try and look after the few rhino still left alive in this difficult country where little control can be exercised over shikaries. The record flood of July, 1929, drove the rhino up into the hills and very few have been allowed by the Lushais to return.

The Indian Buffalo (*Bubalus bubalis*).—The great-horned variety, *macroceros*, formerly existed on the Monas, but had been practically shot out before the formation of the Sanctuary. The writer was fortunate enough to meet the last survivor, a well-known cow, at least a hand higher than the ordinary sized bull with which she was consorting. The Vernay-Fanthorpe Expedition searched for this cow unsuccessfully, and she was never seen afterwards. The best heads come from Central Assam, so there should be some very fine specimens in the adjacent Kazirunga Sanctuary.

The Assamese utilize the services of solitary wild bulls for their domestic cow-buffaloes, a magnificent breed which is bound to deteriorate now that wild bulls are getting scarce, and in the ab-

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sence of anyone interested in scientific breeding. Buffaloes with wild blood in them live longer and are finer draught animals than those of inferior strains, and the cows give more milk. Their disadvantages are sensitiveness to sun and bad tempers.

The wild and tame buffalo of the marshes live largely on the wild rice-plant and are accustomed to warm wallows, but the wild buffalo of the upper reaches of the Monas feed on highland grasses and bathe daily in the cold river water which would be fatal to the marsh-dwellers. These upland buffalo are possibly a little higher on the leg.

The wild buffalo in the Diyung Valley of the North Cachar Hills are very distinctive with short legs, great barrels, and straight horns without the backward sweep before coming forward again to form the tips. Many Mikir Buffaloes ran wild about 1897, when their owners had died from Kala-azar, but probably the whole stock had tame ancestors as they closely resemble the so-called 'Manipuri Buffalo' which is brought through Manipur from Burma for sale in the Surma Valley.

The Gaur (*Bibos gaurus*).—Just as the buffalo is having a bad time from everyone wanting to grow rice where it wants to live, so the gaur, though safe from the Hindu and living in hills in which shifting cultivation alone is practised, is suffering from the hillmen, who sit up at night over saltlicks and plug everything that comes along; consequently it is already only a tradition in many hills where formerly numerous. Solitary bison bulls breed with the tame gayals or Mithun (*Bibos frontalis*) in the neighbourhood of the Kutcha Naga villages in North Cachar and consequently the tame animals there are coloured the same as the wild ones, but wherever there has not been any infiltration of wild blood for a long time, as in the Abor Hills and parts of Manipur, albinism in varying degree is common, many Mithun being pied like Friesian cattle.

A Kachari gamekeeper, a bold man not given to romancing but also not infallible, declares that he has encountered and is scared of a larger, redder, fiercer mithun to be found at a few places on the Bhutan border, and the same story is told by the Mikirs in the hills on the Kamrup-Nowgong border away on the south bank. This may have something to do with the alleged large 'moh-mithun' and smaller 'Goru-mithun' of the Assamese Plains. The writer before he had heard about the supposed red variety was once eating his breakfast at dawn on a cliff while camp was being struck, while two bull mithun were mooning about in the rocky river bed below. One, as ascertained by glasses, was young but was as big as the old black fellow; the young one was very markedly red even to the naked eye at a range of 500 or 600 yds., and was either a freak in colour or else belonged to a separate variety, associating perhaps with one of the black kind after having been driven out from its own herd. Circumstances always arose to prevent the fruition of the expeditions planned to investigate the matter but as there is some possibility, if not probability, about the story being true, it is to be hoped that somebody will one day be able to find time to go and camp in those parts and inquire.

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Swamp Deer, Barasingha (*Rucervus duvaucelii*).—This beautiful deer will soon only be found within protected areas, as it is so easily shot by poachers using elephants in their business. The horns in Assam are poor.

Sambar, Hog Deer, and Barking Deer (*Rusa unicolor, Hyelaphus porcinus, Muntiacus muntjak*) are all common in Assam. The sambar is the big-bodied, solitary Malayan type with small antlers; both sexes display that extraordinary raw patch on the lower side of the neck, for which no reasonable explanation has been suggested. Specimens reared in captivity do not develop it.

The Indian Wild Boar (*Sus cristatus*) is abundant and still interbreeds with village pigs. These without occasional crossing with the wild stock often develop white patches, like the tame mithun, either in the form of blazes or white socks.

Pigmy Hog (*Porcula salvania*).—Not uncommon in places but seldom seems to be shot.

Wild Dog (*Cuon rutilans*?).—All villagers and many Europeans in Assam assert that there are two kinds of wild dog, a larger species hunting in packs. The writer had only come across the latter once and so long ago that he was beginning to think he must have been mistaken until an opportunity occurred a couple of years ago on the Barak in Manipur to observe this small variety at close range. A sambar hind was standing in the water staring into a little hidden bay and occasionally stamping her foot. While the boat was paddled quietly up the pool a wild dog appeared on the bank, apparently to act as sentry, and not noticing the boat at once it proceeded to perch itself on a rock. It was not only considerably smaller and more foxy looking about the ears and muzzle than the familiar wild dog, but in place of the rather short thick tail it had a regular brush, which it curled gracefully forward just as a fox would do when sitting down. There were about a dozen of these dogs round the corner worrying the skin of a sambar fawn, which had been devoured before the very eyes of the mother standing less than 30 ft. away. This was being discussed one day at a station on the hill-section of the Assam-Bengal Railway called Harangajao when a Gurkhali herdsman chipped in to say that both varieties of wild dog killed cattle of his during the Rains: he distinguished them as Hindu and Mussulman dogs. A good reward was promised if he would bring in skins and skulls of both kinds, but without any result.

The most interesting bird that Assam can boast of is the Pink-headed Duck (*Rhodonessa caryophyllacea* Latham), which is possibly extinct elsewhere. There were a good few at one time in some lagoons known to the writer and a few friends, but their number was unfortunately thinned out by a baboo doctor posted in the locality in connection with Kala-azar duty, who was the possessor of a gun and, if he liked eating these duck, of a most indiscriminating palate. The jungle which protects the lagoons is gradually being cleared away and with it the last of the duck is likely to disappear.

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No. 4. *THE UNITED PROVINCES.*

BY

F. W. CHAMPION, I.F.S.

(*Deputy Conservator of Forests, United Provinces*).

One among the numerous striking results of the Great War has been an awakening all over the world to the fact that wild animals are tending to become less and less in numbers in many countries, and often species that were common a few decades ago are being, or actually have been, entirely exterminated. Most of us who went through the War saw far too much of killing ever to want to see any more, and the natural reaction has been that a new spirit of sympathy with wild creatures has become firmly established in many countries. Wild life protection societies are springing up here and there, particularly in America and England, and the Society for the Protection of the Fauna of the Empire is doing great work in trying to preserve the wonderful fauna of the British Empire from further wanton destruction. An enthusiastic branch of this Society has been started in India and a very good work is being done, but unfortunately it is not receiving so much support from Indians as could be desired. Indians, many of whom are prohibited by their religion from taking life, should be the very first to support such a Society and a number are already whole-heartedly doing so, but real mass support has yet to be received. This I believe to be very largely due to lack of knowledge of the aims and objects of such a society, and insufficient propaganda, and I am confident that much greater support will be received in future as a result of the great efforts now being made by the Bombay Natural History Society and the various local branches of the Society for the Preservation of the Fauna of the Empire, which all who have the slightest interest in wild animals should join without a day's further delay. After all, once a species of wild animal has been exterminated, no money, no Society, no human agency can bring that species back to the world, and delay in helping those who are doing their best to save species already threatened with extermination may mean that help, tardily given, is given too late.

Position of Wild life.

The present position in the United Provinces is, perhaps, not quite so bad as in some other parts of India, owing to the presence of a very sympathetic government, an influential Forest Department, and great land-holders, all of whom have always remembered that, within limits, wild creatures have just as much right to exist as the human race. The position inside reserved forests and in certain large estates, which is fairly satisfactory, will be discussed later in this article, but first the present state of affairs in the ordinary districts will be considered. It is the conditions in these ordinary districts, composing 80 per cent or more of the

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whole Province, which are causing so much worry to those who are interested in wild life. Frankly the position is appalling. The vast increase in gun-licenses which has taken place within recent years, combined with the greatly improved means of transport, has caused a drain on the wild life of the districts such as can end only in the almost complete destruction of any kind of wild creature considered to be worth powder and shot. Laws do exist imposing close seasons, but these laws often are not, and cannot be, observed in present-day conditions. Deputy Commissioners and Superintendents of Police in some cases do their utmost, but they are so over-worked nowadays with political and economical troubles that, however keen they may be, they literally have neither the time nor the energy to try to enforce unpopular laws, which, by comparison with present-day troubles, possibly do not seem very important. Further the responsible officers in a district are very few in number and it is quite impossible for them to stop bribery among their often low-paid subordinates. A rupee or two or a piece of meat is quite sufficient temptation to an underpaid *chowkidar* not to report an offence under a Wild Animals' Protection Act, particularly as it is often extremely difficult to prove such an offence, and, even if proved, a subordinate magistrate will generally let off the offender with a purely nominal fine. It therefore seems that, in the present state of the country, any Act enforcing close seasons outside Reserved Forests, however well it may be conceived, is worth little more than the paper on which it is written. In actual fact special efforts are now being made in Hamirpur and Meerut districts to protect *sambar* and *chital*, but it is not known to the writer how far such efforts are proving successful. Animals like black-buck and *chital* and game-birds, both in the plains and particularly the hills, are literally being wiped out at an increasingly rapid rate and one wonders if there will be anything left except monkeys and jackals after another two or three decades. There is one bright spot, however, and that is that non-game birds at least are not harried to the same extent as in England because the egg-collector is scarce, and the average Indian boy, unlike his English confrere, does not amuse himself by collecting vast numbers of birds' eggs, only to throw them away in most cases as soon as the boy begins to grow up. Taken as a whole there is no doubt whatever but that the position in these plains districts of the United Provinces is just about as bad as it could be, but one must always remember that these areas are very densely populated and that really there is not very much room for any considerable numbers of the larger game animals, which must tend to interfere with the cultivator and his crops. In any case leopards are found in many places, since they are prolific breeders and very difficult to keep in check, and, even if more adequate protection were given to the game animals in cultivated districts, it is probable that their numbers would still be kept down by a corresponding increase in the numbers of leopards.

Sufficient has now been written to show that the position in the cultivated districts is very unsatisfactory, but that increasing population in already heavily populated areas, combined with the

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present political and economic distress, makes it very difficult to make practical suggestions for improving matters. What can be done is for large land-holders in sparsely populated districts to preserve restricted areas really efficiently and noble examples of what a great help to the wild life of a country such measures can prove to be is to be found in the great swamp-deer preserves of Oudh, notably those of the Mahrani Saheba of Singahi and of Captain Lionel Hearsey. The former of these has been under careful protection for many years and an area of perhaps 20 square miles now contains several thousand head of these magnificent deer. A few are shot annually, but the number destroyed is almost certainly less than the natural increase, and these public-spirited benefactors can justifiably feel that, so long as they maintain their present standard of efficient preservation, there is no fear of the swamp-deer following the already long list of fine animals which have been exterminated from the United Provinces.

Reserved Forests.

Now the position of wild animals in the Reserved Forests, of which the writer, being a Forest Officer, has perhaps a specialised knowledge, will be considered. Firstly the writer would state most emphatically that United Provinces forest officers as a class are, and always have been, extremely sympathetic towards wild animals. Few are really heavy killers and quite a number do not shoot animals at all, beyond their requirements for food for themselves or their camp followers. An odd individual here and there, both in the present day and in the past, has possibly let his sporting instincts drive him into becoming a really heavy killer, but the amount of slaughter done by the average forest officer in these Provinces is conspicuously small. It sometimes happens that disgruntled sportsmen state that Forest Officers are selfish or destroy more animals than all other classes put together; but these statements are most emphatically untrue and generally have an inner history, which reveals the accuser as having some personal grudge against an individual Forest Officer, which leads him to make general insinuations which are totally unfounded. None could be keener on the preservation of wild life than the present writer, and, if he thought that his brother officers were indifferent to the preservation of wild animals, he would not hesitate to say so. The writer believes that it would be a great mistake to remove the wild animals inside Reserved Forests from the protection of the Forest Department and place them in charge of a separate Game Department. The present system is working very well and such action would be regarded as a slur on Forest Officers and would alienate the all-important sympathy of the powerful Forest Department.

The United Provinces reserved forests are not very extensive and they are all under the personal supervision of divisional forest officers. Poaching does occur to a limited extent, particularly during the monsoon when the forests have to be deserted owing to their unhealthiness, and from motor cars, but such poaching

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is not very extensive and every effort is made to keep it in check. Elaborate rules, which are constantly being amended, do exist for the issue for shooting licenses, for the enforcement of close seasons, and for helping any species which is tending to become scarce. These rules may not be perfect—no rules ever are—but at least their object is to provide shooting for all who apply in the right way, and at the same time to preserve the wild animals in perpetuity without letting them increase to such an extent as to become a nuisance to forest management or to surrounding villagers. Species that, for any particular reason, need help are entirely protected, examples being wild elephants for many years and Sambar in Lansdowne division since an attack of rinderpest in 1927; and senior forest officers are always ready to listen sympathetically to applications for protecting particular animals in particular tracts. Even tigers now have a close season and are not allowed to be shot by artificial light. Some may argue that it is a wrong policy to protect tigers, but at least such protection shows that forest officers consider that even tigers have the right to live in their own jungles.

On the other hand some wild animals, such as deer, do seriously interfere with the management and revenue of valuable forests, and the forest officer cannot allow deer to increase to an excessive extent. In some cases, particularly where the balance of nature has been upset by the excessive destruction of carnivora, deer have become a positive pest, and it has proved necessary to reduce their numbers. Or again, the proportion of hinds may have become excessive, with consequent deterioration in the size of the stags, so that some of the hinds have had to be shot off; but such destruction is stopped as soon as the position becomes normal once again. It is true that individual forest officers, keen silviculturists who have found all their efforts at improving the forests ruined, have occasionally advocated the total destruction of deer; but it is not the general opinion that such drastic measures are required and interesting experiments are now in progress by which considerable areas, in which plantations or efforts at obtaining natural regeneration of valuable trees are in progress, are entirely closed with game-proof fencing, which keeps out the deer. Such fences are somewhat expensive in initial cost, but they can be moved from place to place as required and are probably the best solution for managing forests both in the interest of the forester and also of the indigenous wild life.

It is sometimes stated that, even in the reserved forests, wild animals are much scarcer than they used to be. The writer cannot speak for 30 or 40 years ago since the old records are not clear and he was not in India at that time; but, even if the head of game had diminished, it is possible that the numbers were excessive in the past or that the memories of those who claim that animals are disappearing are a little at fault. After all, most of us tend to think of the 'good old times', although it is possible that those times were not quite so good as they now appear in perspective. An effort has been made to collect figures of animals shot in the past with those shot nowadays for comparison, but

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records of 30 or 40 years ago do not give the information required. The following are the conclusions that the writer draws from the figures that are available:—

(a) Taken as a whole the head of game shot recently has generally not shown any marked decrease, except in the mountain reserved forests, where control is not so easy.

(b) Tigers appear to have increased and marked decreases seem to have taken place in the numbers of *nilgai*, *kakar*, wild-dog and black-buck. The decreases are partly due to serious floods and rinderpest epidemics, and are probably natural fluctuations which will right themselves in time. Wild-dogs have decreased owing to the large reward paid for their destruction.

(c) The decreases in the number of some animals shot recently are due to the removal of rewards as a measure of economy.

(d) It must always be remembered, however, that the number of animals inside Reserved Forests is probably being artificially swelled by the influx of refugees from the appalling conditions at present prevailing outside. This influx will decrease as animals outside become exterminated. Also modern rifles are so good and shooting with the help of a motor-car is so easy, that probably a greater proportion of the existing animal population is shot annually nowadays than was the case in the past.

(e) The Forest Department watches these lists carefully and takes action whenever such action appears to be required.

(f) The general impression of senior forest-officers is that, although there have been considerable fluctuations in particular areas, the game in the United Provinces Reserved Forests as a whole has not markedly decreased during the last 25 years, except in the high hill forests.

To summarise, the present position of wild animals inside the Reserved Forests of the plains and foot-hills of the United Provinces does not give cause for serious anxiety, except for the ever-increasing use of that arch enemy of the wild animal—the motor car. The numbers of wild animals in the mountain reserved forests appear definitely to be decreasing. The position in some zemindari estates is good and in others poorer; and the position in the ordinary districts is almost hopeless.

Some Suggestions.

The writer would make the following suggestions to help the present state of affairs:—

(a) *Public opinion.*—This is by far the most important of all methods of wild life conservation, and, without it, all efforts to preserve wild creatures will prove abortive. Good work is already being done by propaganda and by lectures, but much more remains to be done. Good illustrated books help greatly and the formation of sanctuaries and national parks, where the general public can see wild animals in their natural state, would all help. Major Corbett as local Secretary of the United Provinces branch of the Preservation of the Fauna of the Empire Society is doing a lot to assist in this work.

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(b) *Laws*.—It is much easier in the present state of India to pass a law than to see it enforced, but the writer would greatly like to see laws passed on the following points:—

(1) *Sale of shikar meat, trophies, etc*.—It is of vital importance that a law be passed at an early date totally forbidding the sale of any portion of a wild animal, with certain definite exceptions. Such exceptions would be the dropped horns of deer, and the hides of deer where numbers have to be reduced. Special licences should be issued in such cases and such licences, liable to cancellation at any moment, should be under the personal control of the Divisional Forest Officers, where reserved forests are anywhere near, or under Deputy Commissioners where there are no forest officers. The sale of any *shikar* trophy should be entirely and absolutely prohibited. Such a law, properly enforced, would finish the professional poacher, and would end the nefarious dealings of certain taxidermists who sell *shikar* trophies to those 'sportsmen' who are incapable of bagging anything themselves.

(2) *Limitation of gun licences*.—This is very difficult in the present political state of the country, but at least greater efforts could be made to differentiate between game licences and licences for the protection of the crops, person, property or display. Gun licences for the protection of crops should insist that barrels should be sawn-off short, as such licences are very largely applied for when the real object is poaching.

(3) *Motor cars (and also carts and tongas)*.—The shooting of any wild animal from, or within, say, 400 yards of a motor-car, cart or tonga, either by day or by night, should be made an offence liable to prosecution. The writer personally would like to stop motor cars altogether from entering Reserved Forests, or, where this cannot be done, he would like to place check-chowkies at the entrances and exits of such roads, the cost to be covered by a small wheel-tax. Fire-arms would either have to be deposited at such *chowkies* or would be sealed, so that they could not be used while inside the forests. The excuse of requiring fire-arms for protection en route should not be accepted, as pasengers in motor-cars very rarely need protection from wild animals, except possibly from occasional rogue elephants or man-eaters. Luckily recent economies have resulted in the abandoning of some of the motor-roads in the Reserved Forests of the United Provinces. The writer would like to see them all abandoned! The old time *shikari* or Forest Officer managed perfectly well without them, and they tend only too often to make his modern successor slap-dash and lazy.

(4) *Protection of rare stragglers*.—It occasionally happens that a rare animal, such as a rhinoceros, strays into Reserved Forests from Nepal or elsewhere. Such animals should be rigidly protected with a fine of, say, Rs. 2,000, or imprisonment, for their destruction. The excuse that 'If I don't shoot it, someone else will' should never be accepted in such cases. The recent law passed in Bengal for the protection of the rhinoceros, should be extended to the whole of India.

(5) *Rewards*.—The writer considers that Government rewards

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for destroying wild animals should be given far more sparingly than in the past. Luckily, recent economies have resulted in a great reduction in the rewards offered, and it is sincerely to be hoped that such reduction will be permanent. Rewards in the past have encouraged poachers and have sometimes caused an upset in the balance of nature where they were misapplied. They are really quite unnecessary except for man-eaters and notoriously destructive creatures such as porcupines.

It has been suggested that details of breeding-seasons of various animals should be appended to this article. Inside Reserved Forests every effort is made to protect wild creatures during their breeding seasons and nothing more can be done. Outside Reserved Forests, as already explained in this article, the position is such that protection can very doubtfully be enforced. Hence such an addition to an article which is already too long seems unnecessary, but the writer can supply a list of breeding seasons, so far as they are known, to anyone who is specially interested in the matter.

Since writing the above I have been reconsidering this question and have read up a certain amount of literature on the subject. On the whole I have little to add to what I wrote before except that I am not so certain as I was that the head of game inside the United Provinces' reserved forests is not decreasing. I was posted to N. Kheri Division in 1921 and I returned there again in 1931. Although still a good place for animals in 1931, I would estimate that there had been at least a 25 per cent decrease in nearly all species during that decade. The reasons for this reduction I would put down to (*a*) Motor-cars making shooting far easier than it used to be, (*b*) the destruction of game in the adjoining areas outside the forests resulting in a smaller influx and greater damage to animals straying outside.

I am now in Bahraich division in Oudh, which has a reputation of being a good game division. I have now been here for 5 months and, so far, I have found game of all kinds to be rather scarce, although I hear that more animals come in from Nepal in the hot weather. The reasons for this apparent decrease are the same as in Kheri, i.e., motor-cars and destruction of animals outside the forests, combined with increased poaching along and near the Nepal border.

I have recently heard from Col. A. E. Wood, I.M.S.—a keen supporter of the Darjeeling Natural History Society—that in his earlier days Lachiwala in Dehra Dun division used to be a 'veritable paradise' for wild animals. I am well acquainted with Lachiwala and I can only say that it is very far from being an animal paradise nowadays. It is more a 'paradise' for motor-picnicers from Dehra Dun City and Cantonment!

On the whole I am afraid that there is a distinct doubt that the game inside the reserved forests—particularly in Oudh, where motors now penetrate to every corner—is so plentiful as it was, although the present position does not give rise to the same anxiety as is the case with other areas not under the control of the Forest Department.

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APPEAL

MY studies of the animal remains excavated at Harappa, Punjab, have made it necessary to elucidate the ancestry and determine the various races of Pie dogs of India. For this work it is essential to get together a large series of skulls for comparative study, and I shall be obliged if members of the Society will collect a series of skulls (including the lower jaws) of at least 6 Pie dogs from different localities in India. So far as possible skulls of adult specimens should be collected, and the sex of the individuals noted in each case.

BAINI PRASHAD,
Director,
Zoological Survey of India,
CALCUTTA.

January 23, 1934.

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T. R. BELL,
Karwar,
N. Kanara District,
BOMBAY PY.

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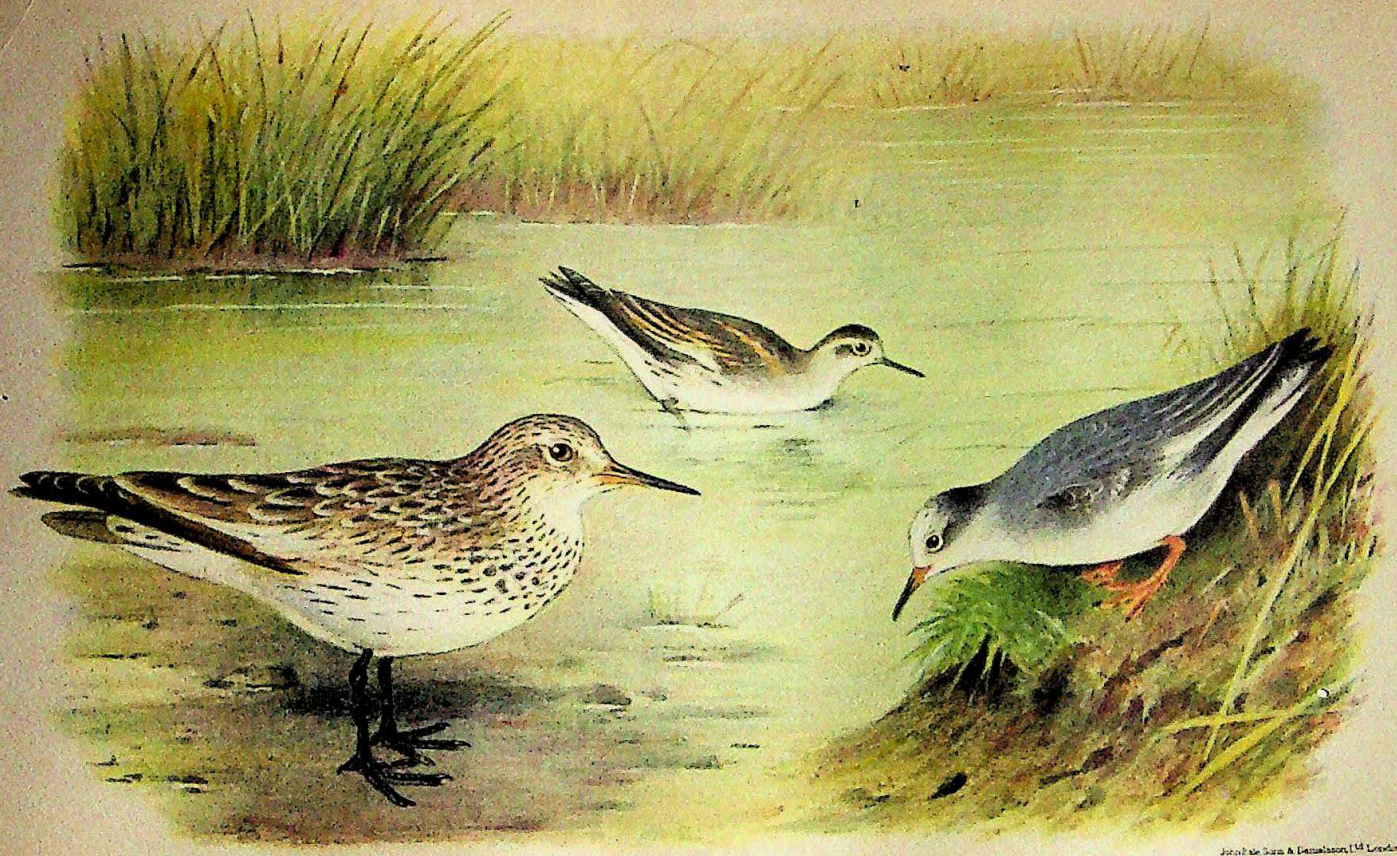

EASTERN KNOT. 1/3
Calidris tenuirostris.

RED-NECKED PHALAROPE. 1/3
Lobipes lobatus.

GREY PHALAROPE (winter). 1/3
Phalaropus fulicarius jourdaini.

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THE GAME BIRDS OF THE INDIAN EMPIRE.

BY

E. C. STUART BAKER, C.I.E., F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V.

THE WADERS AND OTHER SEMI-SPORTING BIRDS.

PART XXI.

(With a coloured plate).

(Continued from page 14 of this volume).

GENUS: CALIDRIS.

Calidris Anonymous, Allg. Lit. Zeitung, 1804, No. 168, col. 542. Type by taut. *Tringa calidris* = *Tringa canatus* Linn.

In this genus the bill is long, straight and stout; both mandibles grooved while the long linear nostril is placed near the base, at the bottom of the groove on the upper mandible; the tarsi are rather short and stout and scutellated throughout; posterior toe present; anterior toes not joined together with webs; the wing is long with first primary longest.

One species of the genus occurs in India and the genus itself is almost cosmopolitan.

CALIDRIS TENUIROSTRIS.

The Eastern Knot.

Totanus tenuirostris Horsf., Trans. Linn. Soc., xiii, p. 192 (1831) (Java).

Tringa crassirostris. Blanf. & Oates, iv, p. 277.

Calidris tenuirostris.—Stuart Baker, Fauna of B. I., vol. vi, p. 247.

Vernacular Names.—None recorded.

Description.—Breeding plumage.—Whole head black, each feather streaked laterally with white, broader on the hind-neck;

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back black, each feather narrowly edged with rufous-white and with a little rufous marking; scapulars with broad chestnut markings on both webs; lower back brown, the feathers edged with grey; upper tail-coverts barred black and white; tail-feathers grey-brown, pale-edged and the lateral also pale-shafted; wing-coverts brown, edged with whitish and with darker centres and shafts; primary coverts and primaries blackish, the latter white-shafted and with paler inner webs; outer secondaries paler and inner secondaries darker again, the former with broader white edges, the latter with rufous-white edges; sides of head, chin, throat and fore-neck white streaked with black; upper breast black with very fine white edges; lower breast and posterior flanks white with blackish spots; centre of abdomen pure white; under tail-coverts white, lightly spotted with black; axillaries white with contour lines of light brown.

Colours of soft parts.—Iris dark brown, bill dusky-black; legs and feet greenish-dusky (Armstrong).

Measurements.—Wing 165 to 185 mm.; tail 63 to 69 mm.; tarsus 34 to 38 mm.; culmen 39 to 47 mm. It is possible that there are two races of this bird, though it is impossible to separate these until the breeding-haunts are known. Indian birds have the wing from 175 to 185 mm., whilst Burmese and Malayan birds have it only 165 to 175 mm.

In Winter the upper parts are pale greyish-brown; each feather with dark shafts, broadening to streaks on the head and neck; longer feathers of the mantle and scapulars with white-edged tips; chin and throat pure white; sides of head and neck, fore-neck, upper breast and flanks white spotted with brown; remainder of lower plumage pure white.

Distribution.—In Summer, Central and Eastern Siberia to Japan. In Winter it is found south to India, the Malay Archipelago and east to Australia. In India it has been obtained on the coasts of Sind and Baluchistan, south to the Laccadives on the West coast; near Calcutta and at Madras on the East coast; on the Andamans and the coasts of Burma.

Nidification.—Nothing recorded.

Habits.—This bird, the breeding haunts of which are not yet definitely known beyond the fact that they are somewhere in Eastern Siberia, is a comparatively rare wanderer in Winter to India and Burma. From there it is found in all the southern countries and some of the islands east to Australia.

In Burma, it was found by Oates in Arakan (Akyab) and by Armstrong near the mouths of the Rangoon river; Wardlaw-Ramsay obtained it in the Andamans; Moore and I myself shot it in Dibrugarh and I had a specimen sent me from Cachar for identification; Jerdon, under the name *canutus*, records it from Madras and Calcutta. In the West it has been found in the Laccadives by Hume and it has been observed in Baluchistan and Sind.

Meinertzhagen records the Western Knot (*Erolia canutus canutus*), a single specimen, from Khushdil in Baluchistan, but I have not seen this specimen.

Very little is recorded about this bird, which is not uncommon on the North-West coasts of India and undoubtedly also visits

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Assam and Burma more frequently than has hitherto been assumed to be the case. I only once shot it in Assam but Messrs. Moore and Mundy also shot two and saw others from time to time, though they found, as I did, that the birds were frequently unapproachable and very wild.

In Sind, where Hume said it was common in his time, Ticehurst writes (Ibis 1924, p. 115):—

'I found it to be the least common of all the waders which frequent the tidal creeks, but as I only saw it at very high tides it is quite likely that it was not shifted from its favourite feeding grounds to places where it could come under observation at other times, normal tides leaving vast areas of mud flat uncovered or only just covered. On the wing it looks a big bird and could not be confused with the Common Knot—indeed I usually found it more difficult to distinguish it in the distance from Bar-tailed Godwits, with which it often associates.

'By the end of April males are in nearly full breeding dress, but females by mid-May are not nearly so far forward, and one on the 17th had only just begun heavy moult. The last seen was 5th June.

'Guadar on the Mekran coast is the Western limit of this bird.'

I only saw this bird when it was evidently on the move in the October and Spring migrations. They were feeding with other waders in vast swamps but were restless and constantly on the move, often, when disturbed, at once flying away out of sight to the South. I should expect them to be not so rare in Winter on the alluvial river banks and flats of the Sunderbands.

The bird I shot, a male, had been feeding on tiny white worms and was in very poor condition on October the 12th. The bird shot in Cachar, in the same month, was comparatively fat.

Subfamily: Phalaropinae.

In this family the toes are bordered throughout by a web divided into lobes very much as in the Coots and Grebes. In other respects they are similar to birds of the genus *Erolia* but, unlike them, the female is bigger and more richly coloured than the male, the latter performing the duties of incubation.

The subfamily contains three genera, each consisting of a single species. Two genera and species are found in India during the cold weather.

Key to Genera.

A. Bill flat, broader than the tarsus and broader than high ... ... *Phalaropus.*

B. Bill slender and subcylindrical, anteriorly narrower than the tarsus ... ... *Lobipes.*

Genus: Phalaropus.

Phalaropus Brisson, Orn., i, p. 50, vi, p. 12 (1760).

Type by taut. *Tringa fulicaria* Linn.

Characters those of the subfamily; the wings are long and

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pointed with the first primary longest; the tail moderate and nearly square; the tarsus scutellated all round; a hind toe present; the bill is short and straight, distinctly flattened or depressed and rather stout; the nostril is placed near the base of the bill in a well-defined groove.

PHALAROPUS FULICARIUS.

Tringa fulicarius Linn., Syst. Nat., 10th ed., i, p. 148 (1758).

Type-locality. Hudson Bay, North America.

This form is said to differ from *P. f. jourdaini* in being darker and less rufous when in full breeding dress.

PHALAROPUS FULICARIUS JOURDAINI.

The Grey Phalarope.

Phalaropus fulicarius jourdaini Iredale, Bull. B.O.C., lxii, p. 8 (1922) (Spitzbergen).

Phalaropus fulicarius. Blanf. & Oates, iv, p. 282.

Phalaropus fulicarius jourdaini. Stuart Baker, Fauna of B.I., Birds, vol. vi, p. 248.

Vernacular Names.—None recorded.

Description.—Female in breeding plumage.—Face blackish-grey; crown and nape black; sides of head white; centre of hind-neck grey, sides deep rufous; mantle velvet-black, the feathers broadly edged with pale rufous or creamy-buff, forming two fairly definite lines down the scapulars; lower back and rump grey in the centre, white laterally; upper tail-coverts rufous, marked with black and white on a few of the central feathers; tail-feathers grey, almost black at the tip, edged with whitish and the two penultimate pairs marked with rufous; wing-coverts grey edged with white, the tips of the greater forming a white wing-bar; primary coverts and primaries dark brown, the latter with white shafts and a few of the later feathers with white edges to the base of the outer webs; outer secondaries brown narrowly edged with white, the central almost all white and the innermost long ones like the mantle; chin grey-black; axillaries and under wing-coverts white; remainder of lower plumage deep rufous, generally with a plum tinge from lower breast to vent.

Colours of soft parts.—Iris dark brown; bill dark horny-brown, orange at the base; legs and feet dull brown or fleshy-brown.

Measurements.—Wing 129 to 142 mm.; tail 56 to 65 mm.; tarsus 20 to 23 mm.; culmen about 20 to 24 mm.

Male in breeding plumage.—Similar to the female but the head duller, the feathers of the crown with rufous edges; the patch of white on the sides of the head smaller and mixed with rufous and white; lower surface often mixed with white. The male is a little smaller than the female. Wing 126 to 135 mm. (Witherby).

Male and female in non-breeding plumage.—Forehead, supercilium, sides of head and neck and whole lower plumage white; hinder crown and nape blackish-brown or brown, running in a line down the hind-neck to the extreme upper back; mantle grey with very fine white edges to the feathers and darker shafts; tail and wings as in breeding plumage.

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Young birds are like the male in Summer but have white foreheads and duller crowns; the chin to breast is rufous-buff fading to white or buffy-white on the remainder of the lower parts.

Nestling in down.—Line from the forehead and crown black, centre of nape dull black; forehead buff, lateral coronal lines pale yellowish-buff; upper parts cinnamon-buff mixed with black and whitish; dorsal line and lines on flanks black; a narrow black eye-streak; chin, throat and upper breast yellowish-white, remainder of under surface greyish-white.

Distribution.—Breeds in the Arctic regions from Iceland and Spitzbergen to Eastern Siberia, its place being taken in the American Arctic by the typical form. In Winter it migrates to the Mediterranean countries, Northern Africa and has once occurred in India, Blyth having obtained a single specimen in the Calcutta bazaar.

Nidification.—Jourdain gives the following notes on some of its breeding places (Ibis, 1922, p. 171) in his account of the birds of Spitzbergen. 'Koenig met with several pairs on the North coast of Bear Island, evidently breeding, on 13-14 July, 1907. In Spitzbergen it occurs locally on many points on the West coast and in Ice Fjord. On the North coast we found it breeding on the Islands in Liefde Bay, as well as on the mainland, in the neighbourhood of marshy pools. Nests were also met with by us on the Edinbergh Isles, the Anser Islands, and the tundra near Cape Bokeman in Ice Fjord. It has also been found on the East side, and breeds on King Ludwig Island (Koenig) and King Charles Land.'

Its nests and eggs are very similar to those of the Red-necked Phalarope but the colonies are often much bigger and the nests are sometimes much closer together. The birds breed both in swampy ground, in actual marsh land and in comparatively dry stretches of short grass, making a nest which consists merely of the growing grass matted down and twisted together to form a pad among the roots of the grass. Rarely they have been known to nest on shingle or open land and here the nest is more substantial, consisting of a deep pad of soft grass in a hollow among the stones and sheltered by tufts of grass or an overhanging stone or boulder. When in deep swamps, tussocks of harder mud and grass are selected and the nest built in among the roots of the latter. The birds are specially fond of islands for breeding purposes but many colonies breed on the mainland, sometimes on the coast and at other times some way inland on the open tundra.

The breeding season, as might be expected of birds so far north, is late. In Iceland early June is the principal time for laying but the bird is rare and very local; in Spitzbergen laying does not start until the end of June or early July, while in the Siberian islands July seems to be the month for eggs.

The full clutch of eggs is probably always four, though it is said that three only are sometimes incubated. These small clutches may, however, be due to accidents or to their being second broods. In appearance the eggs are very like those of the much better known Red-necked Phalarope but average larger and, as a whole, are more boldly blotched with larger markings. Many eggs, however, are

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quite indistinguishable from those of the Red-necked bird. The ground-colour varies from pale stone, or yellowish stone to a warm buff, or brownish buff, blotched or speckled with blackish brown or chocolate brown with sparse subsidiary markings of grey or pale plum colour.

In shape the eggs are the usual pyriform or broad pegtop typical of the *Limicolae;* the texture is close and hard and in some eggs there is a fair gloss.

Jourdain gives the following measurements of 155 eggs. Average 30.4 × 21.8 mm.; maxima *33.8* × 21.2 and 30.5 × *24.5* mm.; minima *27.5* × 20.6 and 28.5 × *20.5* mm.

In both the Phalaropes the female is the dominant partner in domestic affairs. She does make, or at least help to make, the nest and she lays the eggs but, this done, she leaves all the incubation to the male as well as the greater part of feeding and looking after the chicks when hatched.

Habits.—This little bird has only once been found in India. It is not one of the birds which may have been overlooked as its conspicuous grey colour in Winter singles it out from all other waders of like size. If found again it will probably be seen singly rather than in company with other small waders as it is a little bird which seems to keep much to its own kind. In its confiding ways and dainty little motions it is a most charming bird to watch. When the swamp is shallow it may be often seen picking its way about in the grass, feeding as it goes, but it prefers swimming and, as a rule, spends much of its time in the deeper water of pools and open spaces in swamps and marshes. Its food is mainly insectivorous and I have seen it feeding on small 'water spiders' and other surface insects, while it also eats tiny crustacea and mollusca, flies, mosquitoes, etc. It is also said to feed on algae and on shoots and seeds of various water plants. Its actions are sometimes curiously deliberate yet at other times it dashes hither and thither with extraordinary rapidity after small flying insects.

It is extremely tame and allows one to watch it within a very few feet.

Its flight is very much like that of the Stint but less sustained and I have never seen its nuptial flight. Its alarm note has been described by Miss Haviland as 'drrrt-drrrt' but when in flocks the birds keep up a constant twitter, soft and rather low.

Genus: Lobipes.

Lobipes Cuvier, Regne Anim., i, p. 495, '1817' = 1816.
Type by mon. *Tringa lobata* Linn.
This genus differs principally from *Phalaropus* in having a much more slender bill, no broader than high and almost cylindrical.

Lobipes lobatus.

The Red-necked Phalarope.

Tringa lobata ('t' error of type, corrected, p. 824) Linn., Syst. Nat., 10th ed., i, p. 148 (1758) (Hudson Bay, N. America).
Phalaropus hyperboreus. Blanf. & Oates, iv, p. 281.

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Lobipes lobatus. Stuart Baker, Fauna of B.I., 2nd ed., vol. vi. p. 249.

Vernacular Names.—None recorded.

Description.—*Female in breeding plumage*.—Upper plumage dark grey-brown, the scapulars, innermost secondaries and tail darker, each feather edged outwardly with rufous, those on the secondaries and back sometimes obsolete; sides of the rump and lateral tail-coverts whitish; central tail-feathers blackish, the lateral rather paler brown edged with white; wing-coverts dark bluish-grey; the greater broadly edged with white, forming a wing-band; primary coverts and primaries blackish, the latter with white shafts; outer secondaries blackish edged with white; chin, throat and lower sides of head white; sides of neck rich rufous, extending in a band round the fore-neck; sides of breast, sometimes meeting below the chestnut band, grey; flanks, axillaries and under wing-coverts mottled white and grey; remainder of lower plumage white.

Colours of soft parts.—Iris deep brown; bill dark horny-brown to black; legs and feet pale plumbeous or lavender-blue.

Measurements.—Wing, ♂ 105 to 111 mm.; ♀ 110 to 118 mm.; tail 42 to 47 mm.; tarsus about 19 to 21 mm.; culmen 20 to 24.5 mm.

Male differs from the female in having the chestnut of the sides of the neck divided by dark grey on the fore-neck.

In Winter the upper plumage is grey, the feathers of the mantle edged with white; back, rump and upper tail-coverts blackish-grey; wings dark brown, the white wing-bar very conspicuous; forehead, fore-crown, face and sides of the head white; posterior crown blackish-brown; a patch round the eye, running down the ear-coverts, blackish; sides of breast grey; remaining lower parts white.

Young birds have the upper plumage black or nearly so, the feathers of the mantle narrowly edged with warm or pale buff; crown dark brown, extending in a line down the back of the neck; a dark brown line round the lower part of the eye extending over the ear-coverts; sides of head and neck, chin, throat and lower plumage white, the sides of the breast brown or grey-brown.

Nestling in down.—Similar to that of the Grey Phalarope but more richly rufous and without the black line from the forehead to the crown.

Young birds moult direct from the juvenile plumage into the breeding plumage and do not assume an intervening Winter dress but, on the other hand, a good many birds appear to breed in a semi-mature dress, getting a partially red neck and grey breast but retaining the rest of the juvenile plumage.

Distribution.—Breeding circumpolar. In Europe, south to the Orkneys, South Norway, Sweden, Finland, Russia, east to Commander Island and throughout Northern America from Alaska to the Yukon. In Winter it migrates south to North Africa and in Asia to India, Malaya, China and Japan.

Nidification.—The Red-necked Phalarope breeds in Arctic and sub-Arctic regions round the world. It is very common in Iceland and breeds as far south as the Shetlands and the Orkneys. In

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the far North it has comparatively recently been found to breed in Spitzbergen, while I found it breeding commonly in the extreme north of Lapland on the marshes and tundras opposite that country. It seems to be especially fond of islands for breeding purposes and I have seen three or four pairs on tiny islands, hardly more than a small collection of rocks with a few yards of coarse withered grass. It sometimes collects in great numbers in favourite breeding places. Great Heno, an island in the Arctic Ocean, perhaps 3 kilometres long by rather less in width, possesses the usual marshes existing everywhere in the North, and some half dozen shallow lakes or pools surrounded by grass swamp. On this island some 40 or 50 pairs of these birds must breed annually and it is difficult to find a more pleasant way of spending a long Arctic day than one among these most charming little waders. One may not find many nests as they are not too easy to find until one gets to know the tiny owners and their habits, but hardly a minute passes without some little action of interest to note. I have sat on a tussock and had two or three pairs wandering about within a few yards of me and often within a few inches showing the utmost unconcern until finally the little cock thinks it time to settle on the nest and show where it is. Once down he remains down until one almost, or quite, touches him. Often I have not had the heart to disturb him and as one leaves he looks up at one with a quaint little side-long glance as much as to say 'thank you'. Once when standing in this little marsh a Phalarope passed actually between my legs as he darted at some insect on the grass, after which he proceeded to preen his plumage, almost sitting on one of my feet. After about ten minutes at his toilet he dived into a tuft of grass and when I pulled this apart I found him snugly seated on his nest. Touching him with my finger he slipped off but, instead of flying away, stood alongside me peering into the nest and when I stepped back he at once sat down again upon the single egg which had been laid. As a rule when disturbed on the nest the cock-bird flies off, though he often returns as soon as he can, even if the finder remains very close to it. In the Shetlands, where the birds are much disturbed, they are not quite so tame but, even there, I have had the male swim about within a yard or two of me as I examined his nest.

The nests vary a good deal, some being quite well-made little cups of grass and others no more than a mat made by some of the grass being beaten down. On the Fisher Peninsula, where the Phalaropes breed within 50 and 100 yards of the small fishing village, I found two nests which were good examples of the best and worst. One was made just at the edge of a small reedy pool but on dry ground covered with grass only a few inches high and much Reindeer moss. In this latter, the birds had fashioned out a neat little cup, perhaps three inches deep, and then lined it warmly and neatly with the finest shreds of grass, making a bed fully half an inch thick, on which reposed the four eggs. Some twenty yards from this, in the longer grass in a swamp, where the mud and water reached my thighs, was another nest and anything more fragile it would be difficult to conceive. There was no tuft of grass

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but the stems grew close together out of the water and in the centre of a little patch, where the grass grew thicker than elsewhere, the stems and blades had been bent down to form a cradle resting on the water. Possibly a dozen or so stems had been added to the growing pieces but the whole affair was so flimsy that when the eggs were removed I could push my finger through it without using any force. Often the nest is placed on a tussock in a swamp which is covered with coarse or fine grass and then a few bits of grass or moss in a hollow among the roots is all that is considered necessary by the bird.

In the more southern area the breeding season commences in May but in the more northern not until the middle or end of June. Much, however, depends on the season. In the bitter cold of 1931 I found the Phalaropes in Northern Lapland just starting to breed on the 27th June, no eggs having then been laid. In 1933, a year of almost sub-tropical warmth, I found eggs chipping on the 12th June a hundred miles further North. In normal years fresh eggs may be taken any time from the middle of June to the middle of July. In any one colony the birds seem to breed at the same time. Thus in one colony, one year on the 20th June, all the clutches were complete and varied from quite fresh to about five days set. In another colony six miles away, not one bird had begun to lay.

The eggs are invariably four in number and sets of three are abnormal.

Most eggs have a buff-brown varying from pale dull buff to a warm clear brown. Other eggs have an ochre or sandy yellow ground and very rarely there is a faint tinge of green. The markings consist of blotches and specks of brown, sometimes nearly black, sometimes purplish brown and at other times deep reddish brown. In many eggs the blotches are quite small and scanty in number, the specks and spots being dominant; in a few eggs the blotches are vary large and then usually confined to the larger end, though they very seldom form rings or caps. I have one clutch with a sandy yellow ground freely speckled all over with blackish brown; another has a warm buff-brown ground with a few large blotches of purplish-brown at the larger end while a third is a dull oily yellow-brown minutely speckled with deep red-brown, the specks in one egg being confined to the larger end.

In shape and texture the eggs are just the same as those of the Grey Phalarope.

One hundred eggs average 29.6 × 20.9 mm.; maxima *32.0* × 21.3 and 31.0 × *22.2* mm.; minima *26.7* × 19.7 and 22.6 × *19.3* mm.

They are undoubtedly single-brooded. The cock bird alone incubated and the Finns say that incubation takes 15 days.

Habits.—The Red-necked Phalarope arrives in India in the last week of August or the first week in September and then in increasing numbers to the end of the month. I think it occurs inland on migration only but in many coastal districts it is found all the Winter and on the great tidal rivers of Eastern Bengal it may be constantly seen in flocks, often of some size, from October to April, frequenting not only the muddy banks of the rivers but the swamps

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and marshes near them. Ticehurst has a very interesting note on this species in Sind (Ibis, 1924, p. 126). Here it appears to be a passer-through on its Southern journey in September but on the return journey, it seems to go straight on North without a break. At the same time some must stop all the Winter as he says, 'During their winter sojourn off the Sind coast they never come to land, as the sea is never so rough they cannot ride it out'. He also remarks, 'It may be met with in flocks of twenty to a hundred or more, sometimes within a few miles of land, but more often well out to sea. Here they are extremely wild and seldom let a boat come within 200 yards of them', yet inland 'on any small pool or shallow jheel little parties may be met with swimming about. . . . At those times they are absurdly tame.'

This tameness and utter fearlessness of man is their most remarkable characteristic and even when they are on waters frequented by other waders and birds it is seldom they are startled into flight by the sudden departure of the other birds when man gets too close.

They swim far more than wade, sitting very high on the water and moving with great ease and celerity, often darting hither and thither after surface insects but more often daintily picking at odd flies here and there as they leisurely make their way about. They feed on insects of all kinds and also on shoots and seeds of many water plants; some I watched in Lapland were eating small water snails which were feeding on the grass in the swamp. On the islands they were apparently feeding on small shrimps, crustacea and mollusca.

In the swamps where they were nesting both male and female constantly uttered a soft chirring note to one another and they had a sharp but not loud note sounding like 'twit-twit' generally uttered when we first approached.

Their flight is very much like that of the Stints and equally strong but, as a rule, less sustained. When they rise off the nest the flight is very like that of a Dunlin and they occasionally indulge in the same antics, feigning a broken wing or leg, to draw the intruder away.

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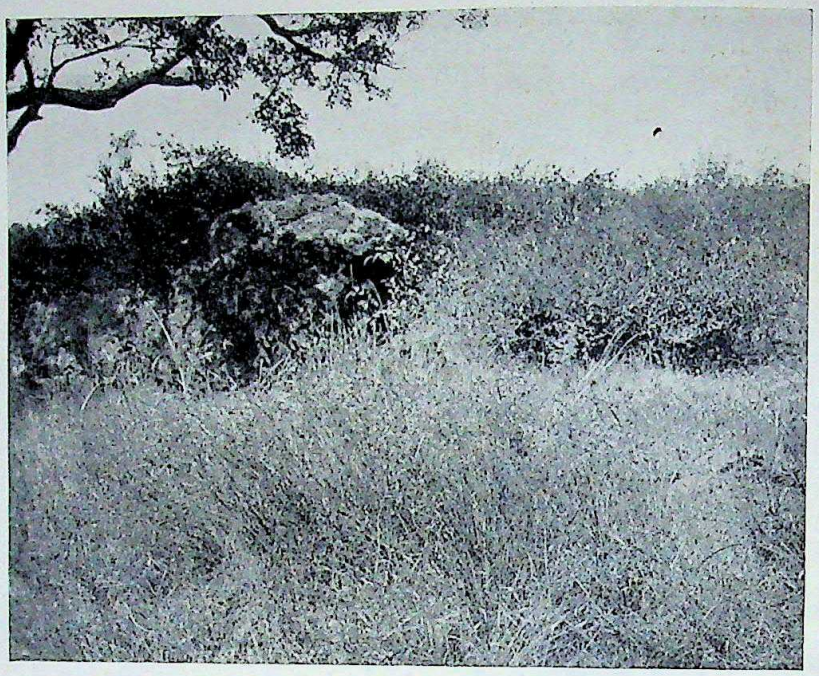

Formation of *P. globosus* Reichb. interspersed with *C. eleusinoides* Kunth at Panchgani.

Cyperus nutans Vahl, growing among bolders of a stream south of the Tulsi Lake, Salsette Island.

Photos by C. McCann.

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REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY.

BY

THE LATE E. BLATTER, S.J., PH.D., F.L.S.

PART XXIV.

(*Continued from page 35 of this volume*).

CYPERACEAE

BY

E. BLATTER, S.J., PH.D., F.L.S. and C. MCCANN, F.L.S.

(*With 3 plates and one block*).

4. CYPERUS Linn.

Annual or perennial erect or floating herbs. Leaves usually radical, flat or terete and channelled, rarely entirely reduced to sheaths. Inflorescence capitate or of simple or compound umbels; bracts like the leaves, rarely reduced almost to scales, usually divaricate, sometimes one erect. Spikelets linear or oblong, usually compressed, seldom terete. Rhachilla persistent, often winged, the wings often interrupted and in pairs opposite the nuts, sometimes united to the glumes. Glumes usually distichous, the 2 lowest empty, 4-many succeeding ones bisexual, the uppermost 1-3 sterile or empty. Stamens 3 or 2, rarely 1; anthers sometimes crested. Style 3-fid, rarely undivided, not tumid at the base nor articulated to the nut. Nut usually 3-gonous, less often plano-convex.

Species about 300.—All warm and temperate regions.

A most difficult genus and in our opinion badly in need of revision. Herbarium material alone is very misleading in the identification of the numerous species. Some of the species are incompletely described and from the descriptions alone may as well be united, as there are no specific differences of real value.

Cooke has 44 species. But then we must remember that his *Cyperus* includes 9 species of *Pycreus*, 3 species of *Juncellus* and 5 species of *Mariscus*. He described, therefore, 27 species of *Cyperus* as considered in this paper. We have united his *C. tegetum* and *C. tegetiformis* with *C. corymbosus*, and again his *C. tuberosus* with *C. rotundus*, so that of Cooke's species there remain 24. Of species new to the Presidency we have added 11.

I. ANOSPORSUM. Style long, undivided or obscurely 3-2-toothed ... ... 1. *C. Cephalotes*.

II. PYCNOSTACHYS. Inflorescence umbellate throughout or capitate; spikelets digitate or clustered, not spicate. Style-branches linear, rarely linear-lanceolate

1. Style-branches linear-lanceolate. Nut corky below ... ... 2. *C. platystylis*.

2. Slender annuals. Umbel very rarely reduced to a single head. Spikelets small. Glumes mucronate

a. Nut not broader upwards ... ... 3. *C. castaneus*.

b. Nut broader upwards ... ... 4. *C. uncinatus*.

c. Nut broadly obovate, suddenly cuneate towards the base ... ... 5. *C. Meeboldii*.

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3. Small or middle-sized, annuals or biennials, rhizome O, or in *C. Haspan* creeping. Leaves and bracts moderately long, narrow, weak. Inflorescence umbellate, sometimes reduced to a single head. Spikelets small, numerous. Glumes scarcely cuspidate
   a. Spikelets innumerable in globose heads, green to blackish ... ... 6. *C. difformis.*
   b. Spikelets fewer in each head
      ¶ No stolons
         † Nut broadly ellipsoid ... ... 7. *C. pulcherrimus.*
         †† Nut globosely trigonous, granulate 8. *C. flavidus.*
      ¶¶ Stoloniferous, nut usually triquetrous 9. *C. Haspan.*
4. Rhizome woody, very short; rootlets wiry. Inflorescence of one head
   a. Glumes very acute, conspicuously mucronate. Nut obovoid, triquetrous, with concave faces, reticulate, black and white ... ... 10. *C. Teneriffae.*
   b. Glumes muticous. Nut sessile, oblong-obovoid, trigonous, black ... ... 11. *C. niveus.*
   c. Glumes oblong-obtuse, obscurely 3-1-nerved. Nut oblong, black, white-reticulate ... ... 12. *C. leucocephalus.*
5. Rhizome woody, creeping; rootlets thick, often woolly. Inflorescence umbelled or with one head
   a. Spikelets in one head, dirty straw-coloured ... ... 13. *C. arenarius.*
   b. Spikelets in a contracted umbel, pinkish grey, roots woolly ... ... 14. *C. conglomeratus.*
   c. Like b, but with many-flowered spikelets and densely crowded glumes ... 15. *C. effusus.*
   d. Spikelets in a contracted umbel, roots wiry ... ... 16. *C. Atkinsoni.*

III. CHORISTACHYS. Inflorescence umbellate, spikes often more or less corymbed. Spikelets (sometimes very shortly) spicate. Style-branches linear

1. Rhachilla of spikelets not much winged. Leaves and bracts long (except in *C. malaccensis*)
   a. Annuals, or sometimes flowering the second year
      ¶ Spikelets compressed; glumes green on the sides ... ... 17. *C. compressus.*
      ¶¶ Glumes nearly always reddish on the sides ... ... 18. *C. glaber.*
      ¶¶¶ Glumes squarrose ... ... 19. *C. aristatus.*
      ¶¶¶¶ Glumes distant, obtuse, golden yellow 20. *C. Iria.*
   b. Rhizome becoming woody; elongate stolons frequent. Large or middle-sized
      ¶ Perennials. Rhachilla of spikelets not much winged, slender. Glumes (mature) with concave backs, not appressed
         † Spikelets very slender, almost filiform, spreading stellately, glumes very distant ... ... 21. *C. distans.*
         †† Spikelets less slender, secund, in tassel-like clusters on the ends of the very long rays ... ... 22. *C. nutans.*

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††† Spikelets less slender, firm, erect, or spreading	23. *C. elcusinoides.*
¶¶ Leafy perennials. Spikelets compressed. Glumes closely imbricating with scarious margins and tips. Tall herbs of marshes	
† Rhachis of spike pilose-scabrid ...	24. *C. pilosus.*
†† Rhachis of spike glabrous ...	25. *C. procerus.*
¶¶¶ Maritime herbs with terete pale spikelets. Glumes crisply incurved all round	26. *C. malaccensis.*
2. Rhachilla of spikelets (usually conspicuously) winged	
a. Stolons slender, soon disappearing, terminating in tunicated bulbils ...	27. *C. bulbosus.*
b. Stolons long, hardening into creeping rhizomes. Leaves short, rarely half the length of the stem. Glumes approximate, closely imbricate	
¶ Bracts 1-3, scale-like, triangular, acute, under 2.5 cm. long	28. *C. articulatus.*
¶¶ Bracts 3-5, linear ensiform, shorter or longer than the inflorescence ...	29. *C. corymbosus.*
c. Rhizome very short, woody; stolons 0, i.e. lateral shoots from base of stem immediately ascending. Glumes not imbricate in fruit. Wings of rhachilla narrow-oblong, hyaline, disappearing	30. *C. macer.*
d. Tall or medium plants, stoloniferous or rhizome woody. Leaves and bracts long. Rhachilla of spikelets winged. Glumes closely imbricated	
¶ Leaves flaccid, flat, umbels expanded, usually compound	
† Tubers not zoned	31. *C. rotundus.*
†† Tubers zoned	32. *C. esculentus.*
¶¶ Leaves rigid, filiform or very narrow; umbel simple, compact ...	33. *C. stoloniferus.*
e. Tall, stout. Stolons 0. Leaves and bracts long. Umbel large, compound. Spikes and spikelets many. Rhachilla of spikelets conspicuously winged. Anthers apiculate, not rarely crested. Style with its 3 branches small. Nut small, ashy black	
¶ Spikelets much compressed, ascending, wings persistent	34. *C. exaltatus.*
¶¶ Spikelets terete, spreading horizontally, wings deciduous	35. *C. digitatus.*

1. **Cyperus Cephalotes** Vahl Enum. ii, 311.—*C. monocephalus* Roxb. Fl. Ind. i (1832) 188.

Description: Glabrous, floating in tanks; stolons slender. Stems 10-40 cm. Leaves 2-5, as long as ¾ stem, 4 mm. broad. Bracts 3-5 up to 10-20 cm., leaf-like. Inflorescence of one compound dense head; heads 3-20 mm. diam. Spikelets 10-70, 6-13 by 3 mm., compressed, rigid, often bent, 10-36-flowered; rhachilla stout, persistent, angular, hardly winged. Glumes closely packed, boat-shaped, green, more or less marked with red or chestnut. Stamens 3-2; filaments broadly ligulate; anthers large, linear-oblong, muticous. Nut stipitate, below corky, half length of glume, ovoid, unequally trigonous (i.e. somewhat plano-convex) passing gradually into the linear style ⅔ length of nut.

Locality: *N. Kanara*: Tank between Mundgod and Haliyal. 2,000 ft., rainfall 40/45 in. (Sedgwick 2404 !); Kirwultu, from tank (Talbot 1125 ! 1539 !).

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Flowering & fruiting: January 5th, 1885 (Kirwultu); March 1917 (Mundgod to Haliyal).

Field notes: Forms floating islands in association with *Pistia stratiotes* in a very few tanks in the above Ghat talukas of N. Kanara (Sedgwick).

Distribution: From Bengal to Madras, Cochin, Travancore, N. Kanara, Burma.—China, Malaya, Australia.

2. **Cyperus platystylis** R. Br. Prodr. 214.—*Anosporum pallidum* Boeck. in Linnaea xxxvi, 412.

Description: Glabrous, floating in tanks. Stolons covered by ovate acute striate pale brown scales. Stems solitary, 15 cm. to 1.05 m. Leaves often as long as stem, up to 8-13 mm. broad, coarse, cutting, nerves many, strong. Umbel 2.5-25 cm. diam.; bracts 20-45 cm. leaf-like, somewhat corymbose. Umbel compound. Spikes near together, often very numerous. Spikelets 5-1,300, 1-6-together digitate, 13 by 3 mm., 20-40-flowered, brown pale or reddish; rhachilla persistent, scarcely winged. Glumes very close-packed, boat-shaped, back with 3 green nerves. Stamens 3; filaments ligulate; anthers linear-oblong, crested with a small linear-lanceolate red mucro. Nut ellipsoid, $\frac{2}{3}$ length of glume, unequally trigonous, pale brown, corky cells of the angles straw-coloured; style much shorter than nut, deciduous, branches as long as style.

Locality: *N. Kanara*: Devimane Ghat (Kulkarni ! 2 sheets); Sirsi (Chibber !).

Flowering & fruiting: May 20th, 1911 (Sirsi); November 20th, 1908 (Devimane).

Distribution: From Bengal and Burma to Ceylon and Penang, N. Kanara.

3. **Cyperus castaneus** Willd. Sp. Pl. i (1797) 278; Cke. ii, 861.

Description: Cke. l.c.

We have examined two sheets identified by C. B. Clarke as *C. castaneus*. The filaments are sometimes long and sometimes short. At times there are two, three and one stamen; style 2-fid, occasionally 3-fid.

Locality: *Konkan*: (Cooke); Bombay (Woodrow ex Cooke); Laddapur (Bhiva ex Cooke), open grassland (H.E.B.B. !).

Flowering & fruiting: September 7th, 1892 (Laddapur).

Distribution: From E. Nepal to Ceylon and Prak.—Tonkin, Central Australia.

4. **Cyperus uncinatus** Poir. Encyc. Méthod vii (1806) 247; Cke. ii, 862.—*C. cuspidatus* H.B. & K. Nov. Gen. *et* Sp. i (1815) 204.

Description: Cke. l.c.

Locality: *Sind* (Pinwill ex Cooke).—*W. Ghats*: Lonavla (Woodrow ex Cooke).

Distribution: Throughout India.—Common in all tropical and warm temperate countries.

5. **Cyperus Meeboldii** Kükenthal in Fedde Report *spec. nov.*, xviii (1922) 315.

Description: No rhizome. Root fibrous. Stems several, caespitose, 6-10 cm. high, setaceous, slightly curved, triangular, smooth, at the base bulbous-thickened, sheaths brown, split into fibres, few-leaved below. Leaves setaceous, canaliculate, as long as the stems. Spikelets 12, oblong, 6 mm. long, scarcely 2 mm. broad, compressed, stellately united into one globose, 8-12 mm. broad head. Bracts 2-3, very much spreading, the lowest quasi a continuation of the culm, much longer than the inflorescence. Rhachilla straight, firm, wingless. Glumes densely imbricate, membranous, fuscescent, 3-nerved from the keeled back, broadly green, excurrent into a short, strong, outward-curved mucro. Nut small, scarcely $\frac{1}{3}$ of the glume, broadly obovate, towards the base suddenly cuneately contracted, trigonous, blackish brown, densely elevately punctate, apiculate. Style short. Stigmas 3, thin. Stamen 1.

Locality: *S. M. Country*: Badami, 2,000-3,000 ft. (A. Meebold 11257).

Note.—According to Kükenthal this species resembles *C. pumilis* Linn. The spikelets and glumes are very similar. But the nuts are trigonous and the style has 3 stigmas. *C. Meeboldii*, therefore, is a true *Cyperus*, not a *Pycreus*. It would be best to put it between *C. jucundus* and *C. Schlechteri*,

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from both of which it can be easily distinguished by the nut being cuneately narrowed towards the base.

Distribution: Endemic.

6. **Cyperus difformis** Linn. Cent. Pl. pt. 2 (1755), in Amoen. Acad. iv (1788) 302; Cke. ii, 862.

Description: Cke. l.c.

Rhachilla narrowly, but distinctly winged by the decurrent margin of the glume.

Locality: *Gujarat*: Kabir Vad, Broach (Gammie !); Sevalia, Kaira Dist. (Chibber !); Vasvad (Chibber !); in sandy bed of stream Chitrasani to Sarotra (McCann 1372 !).—*Khandesh*: Talner, Tapti bank (Blatter & Hallberg 3019 !); Nimb, Tapti River (Blatter & Hallberg 1931 ! 3097 !); Bori River (Blatter & Hallberg 1928 !); Bor, Bori River (Blatter & Hallberg 3024 !, sandy mud 3031 !); Bhusawal (McCann 3088 !); Dadgaum (Blatter, Hallberg & McCann 29582 !).—*W. Ghats*: Khandala (Woodrow ex Cooke); marshes (Sedgwick 2551 !, McCann C92 !, Blatter & McCann 3155 ! 3168 !); Purandhar (Blatter & McCann 5574 !); Igatpuri (McCann 2389 !, Blatter & Hallberg 3209 ! 5119 !); Igatpuri to Kasara (McCann 2389 !); Trimbak (H.E.B.B. !); Matheran (Woodrow ex Cooke).—*Deccan*: Poona, riverside (Bhide 20 !); between Nadsur and Pali, in rice fields (Gammie 16024 !); Ganeshkhind Gardens (Garade 432 !); Bhandala (H.E.B.B. !); Bopodi, near Poona (Gammie 15307 !); Chinchwad, near Poona (Woodrow ex Cooke); between Ellora and Poona (Jacquemont 275 ex Cooke).—*Konkan*: Uran, Bombay Harbour (Hallberg & McCann 2734 ! 2747 !); Pen (Blatter, Hallberg & McCann 3236 !); Bhandup (Blatter & McCann 2419 !); Nagothna to Pen (Gammie 16091 !).—*S. M. Country*: W. of Dharwar, rice fields, 2,000 ft., rainfall 35 in. (Sedgwick 2254 !).—*N. Kanara*: Karwar (Hallberg & McCann C94 ! C98 !, Talbot !); Banks of Kala Nuddi (Talbot 1000 !); Dandeli (Talbot 2271 !); Kilgerry (Talbot 2619 !).

Flowering & fruiting: January 1917 (Uran; Igatpuri); January 11th, 1890 (Dandeli); February 1917 (Pen, W. of Dharwar); March 1917 (Khandala); May 1919 (Khandala); May 8th, 1902 (Poona, riverside); June 1917 (Bhandup); June 13th, 1902 (Ganeshkhind); July 1917 (Khandala); August 13th, 1902 (Bopodi); August 15th, 1891 (Kilgerry); September 1885 (Karwar); September 1914 (Wadaj); September 1918 (Khandala); September 6th, 1911 (Kulgeri, tank); September 13th, 1919 (Ahmedabad); September 20th, 1895 (Bhandala); October 1917 (Igatpuri Ghats); October 1919 (Karwar); October 24th, 1914 (Talod); October 24th, 1929 (Chitrasani to Saro¹ra); November 30th, 1907 (Trimbak); December 1916 (Bhusawal, Taler; Nimb, Bor, Bori River); December 1917 (Purandhar); December 1918 (Dudgaon); December 3rd, 1907 (Sevalia); December 9th, 1902 (Between Nadsur and Pali); December 14th, 1902 (Nagothna to Pen); December 20th, 1904 (Kabir Vad); December 29th, 1911 (Vasvad).

Field notes: A plant met with at any time of the year, generally in sandy soil, in or near streams or other damp places.

The dense round heads of the umbel distinguish it readily. The glumes are at first pale green tinged with reddish brown or purple on the sides, but eventually turn brown—almost the colour of burnt umber in herbarium specimens. Flowers throughout the year under favourable conditions. Specimens collected during the monsoon (late) are best developed.

Distribution: Throughout India and the Old World.

7. **Cyperus pulcherrimus** Willd. in Kunth Enum. ii (1837) 35; Cke. ii, 863.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).

Distribution: Sind, Bengal, Assam.—Ceylon, Penang, Java, Borneo.

8. **Cyperus flavidus** Retz. Obs. v (1789) 13; Cke. ii, 862.—*C. Haspan* var. *indicus* Boeck. in Linnaea xxxv (1868) 574.

Description: Cke. l.c.

The specimen recorded for Cutch, viz. Blatter 1972, may possibly be the plant which was identified as *C. Haspan*.

Nut minute, 0.4 mm., trigonous, sometimes certainly appearing plano-convex, marble white, granulate, frequently adhering to the rhachilla long after the

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fall of the glume. Style 0.5-0.8 mm. long; stigmas 3, linear, occasionally 2, three-fourths the length of the slender style; styles often remain attached to the nut. Glumes deciduous from below upwards. Spikelets up to 10 mm.

Locality: *Cutch*: (Blatter 1972 !).—*Gujarat*: Talod, just out of water, by roadside pond (Saxton 562b !); Sonasan, by a small tank (Sedgwick 332 !); Mehemnagar, near Ahmedabad, rice fields (Sedgwick 331 !).—*W. Ghats*: Igatpuri (Blatter & Hallberg 2801 ! 2802 !, McCann 2388 !); Tingalwadi, Igatpuri (Blatter & Hallberg 1999 !); Khandala (Blatter & McCann 2754 ! 3180 !); Matheran (Gammie 16642 !); Lonavla, in a marsh near Walwan Lake (McCann 1586 !); Castle Rock, on Duski River bank (McCann C126 !).—*Deccan*: (Dalzell & Gibson ex Cooke); Bhusi, Mawal, Poona (Supt. Lonavla Farm 6 !); Sakar Pathar (Gammie 15904 !).—*Konkan*: Pen (Blatter, Hallberg & McCann 3232 !); Uran, Bombay Harbour (Hallberg & McCann 2738 !); Bhandup (Blatter & McCann 2743 !); Mulgaon (Blatter & McCann 3083 !); Andheri (Blatter & McCann 3090 !); Gokhirwa, Bassein (Ryan 86 !); Borivli to Kanari Caves (McCann 1127 ! 1128 !); Vetora (Sabnis 33234 !); Varol Tank, near Bhivandi (McCann 1722 !).—*S. M. Country*: Dharwar, 2,400 ft., rainfall 34 in. (Sedgwick 4976 !); Dastikop, rice fields, 2,500 ft., rainfall 35 in. (Sedgwick 1901 !); Havasbhavi, rice fields 1,800 ft., rainfall 35 in. (Sedgwick 1995 !); Bidi, Belgaum Dist., 2,500 ft., rainfall 60 in. (Sedgwick 2996 !).—*N. Kanara*: Siddhapur, rice fields 1,600 ft., rainfall 100 in. (Sedgwick 7013 !); Yellapur Tank (Talbot 925 !); Karwar, borders of rice fields (Talbot !).

Flowering & fruiting: January 1917 (Igatpuri, Uran); February 1917 (Pen); February 28th, 1884 (Yellapur); March 1917 (Khandala); March 1919 (Castle Rock); May 1918 (Vetora); August 10th, 1885 (Karwar); September 1884 (Yellapur); September 1917 (Igatpuri, Bidi, Lonavla); September 15th, 1929 (Borivli to Kanari Caves); October 1914 (Mehemnagar); October 1917 (Igatpuri); October 1919 (Siddhapur); October 24th, 1914 (Talod); October 26th, 1918 (Lonavla); November 1916 (Bhandup, Khandala, Dastikop); November 12th, 1907 (Bhusi); November 21st, 1902 (Gokhirwa); November 30th, 1929 (Lonavla); December 1907 (Cutch); December 1916 (Havasbhavi, Mulgaon, Andheri); December 1918 (Dharwar); December 1st, 1903 (Matheran); December 5th, 1902 (Sakar Pathar).

Field notes: A monsoon species, but may be met with all the year round in suitable localities. Usually found growing in soft sticky soil of fields and pools. A pest of rice fields; fortunately (as far as we have seen) this plant has no stolons but this is compensated by the large umbel with its minute, numerous seeds. It commences to flower in early September and carries on till the fields are dry.

Its large divaricate umbel, too large for the size of the plant, is unmistakable. Inflorescence at first pale yellow, eventually turning brown. Stems 3-gonous, with a ridge on every side making it appear hexagonous until cross-sectioned.

Distribution: More or less throughout India, Ceylon.—The Old World, generally in warm regions.

9. **Cyperus Haspan** Linn. Sp. Pl. (1753) 45; Cke. ii, 863.

Description: Cke. l.c.

We are much inclined to believe that the record for Cutch is not correct as this species is a plant inhabiting heavy rainfall country. We have not seen specimens in any herbarium from the drier parts of the Presidency.

This species is exceedingly difficult to separate from good specimens of *C. flavidus*.

We are of opinion that the Cutch and Deccan specimens are more likely *C. flavidus* and not *C. Haspan*.

Locality: *Cutch*: (Blatter ex Journ. Bom. Nat. Hist. Soc., Flora of Cutch).—*Konkan*: Ratnagiri (Woodrow ex Cooke; Herb. Col. of Sc. Pa. now in Calcutta !; H.E.B.B.); Vetora (Sabnis 3371 !).—*W. Ghats*: Lonavla (Woodrow ex Cooke); Castle Rock, 1,700 ft. rainfall 200 in. (Sedgwick 5600 !, Gammie 15765 !, Bhide !).—*N. Kanara*: 30 miles E. of Karwar, rivulet by road, 400 ft., rainfall 150 in. (Sedgwick 6571 !); Devimane Ghat, 600 ft., rainfall 250 in. (Sedgwick 6950 !); Sulgeri, 1,000 ft., rainfall 200 in. (Bell 4246 !); Ramangoli, 1,000 ft., rainfall 200 in. (Sedgwick 3475 !); Anmod, rice fields, 2,000 ft., rainfall 200 in. (Sedgwick 3275 !); Yellapur (Talbot !), Arbail Ghat, 1,800 ft., rainfall 200 in. (Sedgwick 5846 !).

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Flowering & fruiting: February 28th, 1884 (Yellapur); March 1919 (Castle Rock); April 1919 (Yellapur, Arbail Ghat); August 1918 (Sulgeri); October 1918 (Vetora); October 1919 (Karwar, Devimane); October 27th, 1902 (Castle Rock); November 10th, 1911 (Castle Rock); December 1917 (Anmod); December 1919 (Ramangoli); December 25th, 1893 (Ratnagiri).

Field notes: A weak looking plant with very large umbels.

Distribution: Confined to the heavy rainfall areas of the Bombay Pres., throughout India, in marshy localities and in rice fields.—Ceylon, Malaya, Indo-China, tropical Africa and Australia.

10. **Cyperus Teneriffae** Poir. Encycl. Méthod. vii (1806) 245; Cke. ii, 861.—*C. Wightii* Nees in Wight Contrib. (1834) 78.—*C. rubicundus* Kunth Enum. ii (1837) 49 (*non* Vahl).

Description: Cke. l.c.

Locality: *Deccan*: Poona (Woodrow 143 ex Cooke, Herb. St. X.C. 3140 !); Gungapur, Nasik (Blatter & Hallberg C102 !).—*S. M. Country*: Varavandi, Ahmednagar Dist. (Herb. Sedgwick 7387 !); Dharwar, weed on poor land, 2,400 ft., rainfall 35 in. (Sedgwick 2880 !).

Flowering & fruiting: February 1920 (Varavandi); September 1917 (Gangapur, Dharwar).

Field notes: Confined to the drier open tracts of the Presidency. A very characteristic species.

Distribution: Deccan, S. M. Country, Nallamalai Hills, Coromandel, Nilgiris, Anamalai Hills, Travancore.—S. and tropical Africa, Teneriffe, Madagascar, Arabia.

11. **Cyperus niveus** Retz. Obs. v (1789) 12; Cke. ii, 864.

Description: Cke. l.c.

Locality: Without locality (Dalzell, H.I.F.I. !).—*Sind*: (Pinwill ex Cooke); Hyderabad (Woodrow ex Cooke).—*Gujarat*: Ahmedabad, sandy hills (Sedgwick !, Saxton 1718 !), on cultivated and waste land fairly common (Saxton 1718b !); Bodeli (Col. of Sc. Herb. now in Calcutta !, Woodrow !).

Flowering & fruiting: July 1914 (Ahmedabad); July 6th and 12th, 1919 (Ahmedabad).

Distribution: Confined to the dry sandy tracts of the Presidency, Rajputana, N. Circars up to 1,500 ft., Rampa, more or less throughout India.—Afghanistan, China.

12. **Cyperus leucocephalus** Retz. Obs. v (1789) 11; Cke. ii, 864.

Description: Cke. l.c.

Locality: Without locality (Dalzell, H.I.F.I. !).—*Konkan*: Parol, Bassein Range (Ryan 2442 !); Kaman, Bassein (Ryan 1160 !); Vetora (Sabnis 33553 !); N. & S. Konkan (Law ex Cooke).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4039 !); Astoli, in grass near forest, 2,000 ft., rainfall 100 in. (Sedgwick 2607 !).—*N. Kanara*: Karwar, rice fields (Talbot !).

Flowering & fruiting: May 1918 (Vetora); June 1918 (Devarayi); July 1917 (Astoli); July 26th, 1904 (Parol); August 10th, 1885 (Karwar); August 19th, 1903 (Kaman).

Distribution: Konkan, S. M. Country, N. Kanara, Deccan, Madanapalle, Cuddapah, Martaban.—Tropics generally.

13. **Cyperus arenarius** Retz. Obs. iv (1786) 9; Cke. ii, 864.—For synonyms see F.B.I. vi, 602.

Description: Cke. l.c.

'Rhizome slender, creeping, 12 inches or more, below the shoots erect' (Saxton).

Stems up to 59 cm. excluding the inflorescence. Inflorescence occasionally with 3 rays with 6-8 sessile spikelets. Rays 15 mm. long. Bracts 5, the longest up to 21 cm. diminishing in size (upwards) to 7 mm., the smallest being lost among the spikelets.

Locality: Without locality (Dalzell H.I.F.I. !).—*Sind*: (Pinwill ex Cooke, Stocks ex Cooke); Karachi, by railway line (Hooper 38717 !, Dalzell Herb. Calc. !); Gharo (Blatter & McCann D718 !); Jamadar ka Landa near Karachi

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(Stocks ex Cooke).—*Cutch*: on the sea coast (Blatter ex J.B.N.H.S.).—*Gujarat*: Ahmedabad (Woodrow 21 ex Cooke, H.E.B.B. !), river bed (Sedgwick 7416 !), dry sand hills (Sedgwick !); Sarkhaj road, sand area, close to river, Ahmedabad (Saxton 1781 !); in deep sand, Chitrasani to Sarotra (McCann 1364 !); Dumas near Surat, on the sea-coast (Dalzell ex Cooke); Tithal, Bulsar, sand dunes (Chibber !).—*Konkan*: Shore, Salsette-Bombay (Blatter Herb. Sedgwick 3582 !); Juvem, Salsette (Blatter, Hallberg & McCann 3040 !); Bassein (Paranjpye !); Versova, sand dune (Blatter, Hallberg & McCann 29574 !).—*N. Kanara*: Karwar, sandy seashore (Sedgwick 5082 !, Talbot 553 ! 663 ! 997 ! 1533 ! 1536 !).

Flowering & fruiting: March 1918 (Salsette); July 1914 (Ahmedabad); July 1918 (Versova); July 1920 (Ahmedabad); July 30th, 1883 (Karwar); August 2nd, 1919 (Ahmedabad); August 9th, 1912 (Bassein); August 12th, 1912 (Karachi); September 1916 (Juvem); September 20th, 1885 (Karwar); October 24th, 1929 (Chitrasani to Sarotra); December 1918 (Karwar); December 27th, 1911 (Tithal).

Field notes: A species of sandy localities. In the Palanpur State we have found this species growing in dry, sandy river beds, which are dry for the greater part of the year. The culms and roots descend deep into the earth making it difficult to extract.

Distribution: India, sea-coast from Sind to Ceylon and Orissa, Punjab Plains, Rajputana.—Persia, Arabia.

14. **Cyperus conglomeratus** Rottb. Descr. *et* Ic. (1773) 21, t. 15, fig. 7; Cke. ii, 865.—*C. pungens* Boeck. in Linnaea xxxv (1868) 537.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke); Karachi (Ticehurst 7301 !); Sibi (Lace 3462 ex Cooke).—*Cutch*: (Blatter ex J.B.N.H.S.).—*Gujarat*: Ahmedabad (Saxton !), sandy hills (Sedgwick !, Woodrow ex Cooke).

Flowering & fruiting: July 1914 (Ahmedabad).

Field notes: Grows in sandy country in both wet and dry places.

Distribution: Sind, Cutch, Gujarat, Baluchistan.—Ceylon, Arabia, Mediterranean region, tropical Africa.

Var. pachyrrhizus Trimen MS. ex Hook. f. in Trimen in Fl. Ceylon v (1900) 23; Cke. ii, 866.—*C. pachyrrhizus* Nees ex Boeck. in Linnaea xxxv (1868) 111.

Description: Trimen l.c.

Locality: *Kathiawar*: Veraval (Woodrow !); Porbandar (Chibber !, Bhide !, Javlekar !, Blatter 3135 !, Woodrow !).—*Konkan*: (Law ex Cooke).

Flowering & fruiting: January 7th, 1910 (Porbandar); April 20th, 1909 (Porbandar); December 1891 (Veraval).

Distribution: Kathiawar, Konkan, Madras Pres. (coastal sands, Krusadai Island), Laccadive Isles.—Ceylon.

15. **Cyperus effusus** Rottb. Descr. *et* Ic. 22, t. 12, fig. 3.—*C. conglomeratus* var. *effusus* Boiss. Fl. Or. v, 369.—*C. conglomeratus* var. *major* Boeck. in Linnaea xxxv, 544 (*partim*).

Description: Spikelets linear, compressed, 20-60-flowered, 8-25 by 2-3 mm., much narrower than in *C. conglomeratus*; glumes most densely packed, scarcely mucronate, otherwise as *C. conglomeratus*.

Locality: *Sind*: (Pinwill ex C. B. Clarke).

Distribution: Sind.—Arabia, Socotra, Syria, Egypt, tropical Africa.

16. **Cyperus Atkinsoni** C. B. Clarke in Journ. Linn. Soc. xxi (1884) 109; Cke. ii, 865.

Description: Cke. l.c.

Locality: Without locality: (Dalzell ex Cooke).—*Sind*: (Stocks ex Cooke); Jamadar ka Landa, near Karachi (Stocks ex Cooke).

Distribution: Kashmir, N.-W. Himalaya, Sind.

17. **Cyperus compressus** Linn. Sp. Pl. (1753) 46; Cke. ii, 866.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Nadiad (Chibber !); Roho to Chitrasani (Allan, Herb. McCann 1055 !).—*Deccan*: (Dalzell & Gibson ex

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Cooke); Deolali (Blatter & Hallberg 2833 ! 2835); Lena Hill, Nasik (Blatter & Hallberg 2832 !); Poona (Ranade !, Woodrow ex Cooke), College Garden (Garade 747 !).—*W. Ghats*: Khandala, St. Xavier's Villa (McCann C113 !).—*Konkan*: Bombay, St. Xavier's College grounds (McCann 2399 ! 4238 !); Juvem (Blatter & McCann 3084 !); Bandra (Blatter & McCann 2367 !), foreshore (Vakil C111 !), fields (Vakil C112 !); N.-E. shore of Vehar Lake (McCann 639 ! 640 !).—*S. M. Country*: Badami (Herb. St. X.C. 3136 !); Badami Hills (Paranjpye !).—*N. Kanara*: Karwar (Bell 2697 !), rice fields (Talbot 1254 ! 1305 !); Kumpta (Chibber !).

Flowering & fruiting: June 1916 (Bombay); July 1917 (Bombay, Karwar); July 1919 (Bandra); July 7th, 1929 (Vehar Lake); August 6th, 1916 (Bombay); August 12th, 1902 (Poona); August 12th, 1929 (Roho to Chitrasani); September 1885 (Karwar); September 1917 (Lena Hill, Deolali, Bandra); September 1919 (Khandala); September 1st, 1912 (Badami Hills); September 6th, 1912 (Nadiad); September 22nd, 1895 (Poona); November 1891 (Badami); November 1st, 1910 (Kumpta).

Field notes: Purely a monsoon species, but may be met with by streams and other water at almost any time of the year. A very prolific species. Very common in the islands of Bombay and Salsette, by roadsides, drains, waste land and on paths.

The period of activity of this species is from a month and a half to two months. These remarks apply to the individual plants (and not to the whole). Soon after the plants have shed their seed new individuals spring up.

A tufted species with many stems arising from the same base; there are no stolons or rhizomes. Possibly the tufted appearance is brought about by a portion of the spikelet germinating in the same spot.

Distribution: Throughout India.—In nearly all tropical and subtropical countries.

18. **Cyperus glaber** Linn. Mantiss. (1771) 179.

Description: Annual, with fibrous roots, stems triangular-subcompressed, leafy below. Leaves flat, shorter than the stems. Umbels often subcompound; rays 4-8, the central one often the shortest. Bracts unequal, the largest very long; spikelets very closely spicate, more or less red-tinged, linear-lanceolate, compressed, subsessile; glumes muticous or very nearly so, ovate-oblong with a green keel, the sides 3-nerved, purplish, white-margined, obtuse, the keel excurrent, mucronulate; rhachis not winged; stamens 3; style 3-fid. Nut black, obovate, triquetrous, minutely conic-apiculate.

Locality: *Sind*: (Pinwill ex C. B. Clarke).

Distribution: From Sind westward to Sicily.

19. **Cyperus aristatus** Rottb. Descr. *et* Ic. (1773) 23, t. 6, fig. 1; Cke. ii, 866.

Description: Cke. l.c.

Locality: *Gujarat*: Ahmedabad, sandy places (Sedgwick !), nala near Wadaj (Sedgwick 306 !).—*W. Ghats*: Khandala (Blatter, Hallberg & McCann 2403 ! 2404 ! 3064 !); Purandhar Fort (Bhide 988 !); Panchgani, very common (McCann !); Londa, on wet rocks (Gammie 15860 !).—*Deccan*: Gungapur, Nasik (Blatter & Hallberg 2837 !); Lena Hill, Nasik (Blatter & Hallberg 2363 !); Deolali (Blatter & Hallberg 4557 !); Talegaon (Herb. St. X.C. 3134 !); Khadkalla to Talegaon (Woodrow !); Poona (Talbot !, Jacquemont 315 ex Cooke, Woodrow ex Cooke), Parvati Hill (H.E.B.B. !); Kirkee, Mr. Gammie's compound (H.E.B.B. 903 !); Khed (Paranjpye !); Shivneri Fort, Junnar (Paranjpye !).—*Konkan*: Kondita, Salsette Isl. (Blatter & McCann 1852 !); Bombay, Antop Hill (Blatter & McCann 2424 ! 2448 !); Victoria Gardens (Blatter & McCann 2391 !), St. Xavier's College grounds (McCann 2847 !); Bandra (Ryan 1256 !), seashore (Gammie 2482 !); Alibag Fort (Bhide !); Narel (Herb. Col. of Sc. Pa. now in Calc. !).—*S. M. Country*: Dharwar, 2,400 ft., rainfall 34 in. (Sedgwick 2943 ! 6196 ! 6357 !, Talbot 2620 !); Badami Hills (Paranjpye !).—*N. Kanara*: Karwar, sea-face, rainfall 120 in. (Sedgwick 6711 !).

Flowering & fruiting: July 1914 (Ahmedabad); July 1917 (Condita); July 1919 (Bombay, Khandala); August 1917 (Antop Hill); August 1919 (Dharwar);

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August 8th, 1904 (Bandra); August 10th, 1904 (Bandra); August 15th, 1891 (Dharwar); August 21st, 1891 (Narel); August 30th, 1903 (Bandra); September 1888 (Parvati Hill); September 1914 (Wadaj); September 1917 (Lena Hill, Deolali, Dharwar, Gangapur); September 1919 (Dharwar); September 1st, 1902 (Kirkee); September 1st, 1912 (Badami Hills); September 10th, 1911 (Shivneri Fort); September 11th, 1911 (Khed); September 22nd, 1902 (Purandhar Fort); September 26th (Khadkalla to Talegaon); October (Talegaon); October 1919 (Karwar); October 9th, 1910 (Alibag Fort); November 3rd, 1902 (Londa).

Field notes: An extremely common species in the town of Bombay, soon after the break of the monsoon. It grows in ditches, on walls, pathways, waste land, and is even to be found in choked gutters on roof tops.

The inflorescence is at first quite green, in keeping with the whole plant; but turns brown when mature.

As far as we have been able to judge it grows best on soil containing gravel and lime. Firm soil appears to be preferred on which the plant thrives best.

Distribution: More or less throughout India.—Ceylon, tropical Africa, Australia, the whole of America.

20. **Cyperus Iria** Linn. Sp. Pl. (1753) 45; Cke. ii, 867.—*C. Iria* var. *paniciformis* C. B. Clarke in Hook. f. F.B.I. vi, 607.

Description: Cke. l.c.

Cooke mentions that the variety *paniciformis* bears two nuts, but does not say how many nuts the species bears.

A sheet in the Herbarium of the Gujarat College, collected by Sedgwick shows the typical species and the variety growing on the same plant.

Locality: Without locality (Dalzell H.I.F.I. !).—*Sind*: Karachi, extracted from a bird's crop and grown in a pot, Ticehurst No. 17 (Herb. St. X.C. 28958 !).—*Cutch*: In rice fields (Blatter, ex J.B.N.H.S.).—*Gujarat*: Nadiad (Chibber !); Ahmedabad-Bhadar, famine grass plot (Sedgwick !); Ahmedabad (Blatter 2170 !), nala near Wadaj (Saxton 1816 !), sandy fields (Sedgwick !); Vastrapur, in a flooded field (Saxton 1883 !).—*W. Ghats*: Igatpuri (Blatter & Hallberg 2407 ! 2803 ! 3206 !); Khandala (Woodrow ex Cooke, Sedgwick 2560 !, Blatter & McCann 3162 !, Blatter, Hallberg & McCann 1993 ! 1994 ! 3046 !); Khandala to Campoli (Blatter, Hallberg & McCann 27603 !); Lonavla (H.E.B.B. !); Purandhar (Blatter & McCann 5583 ! 5585 !), Bairawadi Purandhar (Blatter & McCann 5577 ! 5580 !); near Shivapur village, Poona Dist. (Fernandez C157 !); Panchgani (Blatter & Hallberg B1750 !, D'Almeida C209 !, McCann 2982 !); Matheran (Woodrow ex Cooke).—*Deccan*: (Dalzell & Gibson ex Cooke); Nasik, Lena Hill (Blatter & Hallberg 2823 ! 2841 !), Gangapur (Blatter & Hallberg 2824 !); Bopodi, near Poona (Gammie 15308 !); Shivneri Fort, Junnar (Paranjpye !); Poona (Jacquemont 344 ex Cooke); *Konkan*: Pen, rice fields (Blatter, McCann & Hallberg 3235 !); Sion (Blatter & McCann 2364 !); Bombay, St. Xavier's College compound (McCann 2100 !); Mahim (Blatter & McCann 2730 !); Palghar, Mahim (Ryan 1781 !); Trombay, on hill (Blatter & McCann 2827 !); Juvem (Blatter, Hallberg & McCann 3086 !); Bassein (Blatter & McCann 2369 !); Bandra (Ryan 1367 !), fallow fields (Vakil C99 !); Neral (H.E.B.B. !, Bhiva ex Cooke); Parsik (Ryan 1214 !); Mulland (McCann 813 ! 905 !); Borivli to Kanari Caves (McCann 1159 !); Bhandup to Vehar Lake (McCann 646 !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4459 !); Dharwar, in water hole, 2,400 ft., rainfall 34 in. (Sedgwick 6208 !); Shiggaon, 2,000 ft., rainfall 35 in. (Sedgwick 2116 !); Badami Hills (Paranjpye !).—*N. Kanara*: Yellapur (Talbot !); Dandeli, 1,800 ft., rainfall 100 in. (Bell 4218 !).

Flowering & fruiting: January 1917 (Igatpuri); February 1917 (Pen); March 1917 (Khandala); May 1917 (Khandala); June 1917 (Sion); July 1916 (Khandala); July 1917 (Bombay); July 7th, 1929 (Bhandup to Vehar); August 1908 (Bombay); August 1914 (Ahmedabad); August 1916 (Khandala); August 1917 (Sion, Kanari Caves); August 1918 (Dandeli); August 1919 (Dharwar); August 11th, 1929 (Mulland); August 13th, 1902 (Bopodi); August 16th, 1919 (Wadaj); August 22nd, 1929 (Shivapur); August 23rd, 1903 (Parsik); August 29th, 1919 (Vastrapur); September (Trombay Hill); September 1916 (Juvem); September 1917 (Gangapur, Igatpuri Ghats, Bassein, Bandra); September 1919

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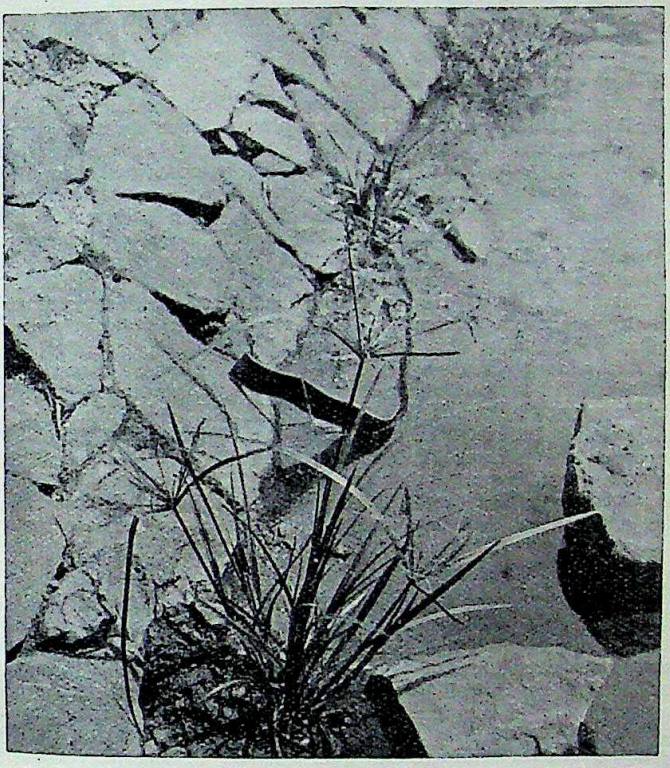
(Khandala); September 1st, 1912 (Badami Hills); September 6th, 1912 (Nadiad); September 10th, 1911 (Shivneri Fort); September 15th, 1903 (Jootara); September 20th, 1884 (Yellapur); October 1917 (Igatpuri); October 1918 (Devarayi, Campoli); October 1920 (Panchgani); November 1916 (Mahim); November 2nd, 1905 (Lonavla); November 16th, 1903 (Palghar, Mahim); December 1916 (Shiggaon); December 1917 (Purandhar).



Cyperus Irea L. growing in a drain, Khandala.

Field notes: Mainly a monsoon plant, but may be met with at any time of the year near water or in marsh land. Appearing soon after the break of the monsoon everywhere. A most variable plant (perhaps the most variable of all the *Cyperaceae*) varying from a fine filamentous form, a few inches high with just one reduced spikelet of a few glumes to a form 0.9 m. high with large compound umbel. Specimens growing in streams usually reach a large size whereas those on 'drier' soil remain small.

A curious point is that the so-called variety *paniciformis* is developed in specimens which have an excess amount of water and hence the 'variety' is a pest in flooded fallow fields. The umbel in this form is usually larger with smaller glumes. In short, the 'type' grows on firm 'drier' soil than the variety. The type is smaller than the variety, with a much more regular umbel, with large glumes.

We have seen specimens of this species presenting both the typical and varietal forms on the same plant; Sedgwick's Nos. 2116 and 6208 are good examples. Under these circumstances and considering the fact that this species is very variable between considerable limits, we have dropped the variety.

The roots in fresh specimens are reddish or reddish purple and aromatic. (This remark applies to the 'form'.)

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The form *paniciformis* is more a monsoon form than the typical form but the typical form alone is usually the form met with in marshes during the dry season.

We have also noticed the form *paniciformis* growing on firm soil, but this is seldom the case compared with the vast number found in water-logged soil. In Salsette we have observed it entirely covering fallow fields during the monsoon almost to the exclusion of everything else.

Distribution: Throughout India in rice fields.—Ceylon, China, Japan, Malaya, Australia, Persia, Afghanistan, tropical Africa.

21. **Cyperus distans** Linn. f. Suppl. 103; C. B. Clarke in Hook. f. F.B.I. vi, 607.—Synonyms in C. B. Clarke l.c.

Description: Glabrous, large or medium sized. Stolons elongate, hardening into a stout horizontal rhizome, but many plants flower the first year. Stems 0.3-0.9 m. long. Leaves often as long (or ⅔ as long) as the stem, 6-8 mm. broad. Umbel compound, usually open 20-30 cm. in diam., sometimes congested or depauperated; bracts usually overtopping the umbel, similar to the leaves. Spikelets usually spicate (rhachis of the spike 8-50 mm. long), 13-38 by 1 mm., almost acicular, reddish, 10-12-flowered, in fruit divaricate at right angles; rhachilla very slender, not winged, appearing zigzag in the lower half where the glumes have fallen. Glumes very remote, oblong-elliptic, obtuse. Nut ½-⅔ the length of the glume, oblong or narrow-ellipsoid, trigonous, dusky-black, style much shorter than the nut; branches 3, shortly exserted.

Locality: *W. Ghats*: Lingmala, near the falls (McCann 3409 ! 3426 ! 3427 !); Castle Rock (Gammie 15573 !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4432 !); Devikop, 1,800 ft., rainfall 40 in. (Sedgwick 4440 !); Belgaum (D.F.O. 10416 !, Herb. I.F.R.I.).—*N. Kanara*: Yellapur, 1,800 ft., rainfall 100 in. (Sedgwick 6546 !): Siddhapur, 1,600 ft., 100 in. (Sedgwick 7021 !); Karwar (Talbot 1514 !, Hallberg & McCann C198 !).

Flowering & fruiting: September 24th, 1930 (Lingmala); October 1918 (Devikop, Devarayi); October 1919 (Yellapur, Siddhapur, Karwar).

Field notes: The three specimens obtained by us were partly in forest among other plants on the bank of the Yenna River. The spikelets were rusty brown.

Distribution: From the Himalaya to Ceylon and Singapore.—In nearly all warm countries.

22. **Cyperus nutans** Vahl Enum. ii (1806) 363; Cke. ii, 868.

Description: Cke. l.c.

Rhachilla broadly winged by the decurrent margins of the glumes. Wings hyaline, easily detachable—the rhachilla often appearing wingless on this account.

Woodrow's Marval specimen was identified as *C. eleusinoides*.

Locality: Without locality (Dalzell ex Cooke).—*W. Ghats*: Igatpuri (McCann 2383 !, Blatter & Hallberg 5170 !); Mahableshwar (Talbot 4541 !); Panchgani (Blatter & Hallberg B1752 ! B1753 !); Khandala (Woodrow ex Cooke, Blatter & McCann 2756 !); Castle Rock, 1,600 ft., rainfall 250 in. (Sedgwick 2759 !).—*Deccan*: Marval (Woodrow !); Lohogahad Fort, top (Blatter, Hallberg & McCann C136 !); Mawal, Poona Dist. (Blatter 3137 !).—*Konkan*: In a rocky stream-bed, south of Tulsi Lake, among rocks (McCann 1274 ! 1281 ! 1283 ! 1284 !); Borivli to Kanari Caves, in rocky stream-bed (McCann 1102 ! 1121 ! 1122 ! 1123 !); Foot of Kanari Caves (Blatter, Hallberg & McCann 28622 ! 28639 !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4466 !).—*N. Kanara*: Sampkhand, riverbank (Sedgwick 6981 !, Hallberg & McCann C108 !); Yellapur (Talbot !); pools below Gersoppa Falls (Sedgwick 7107 !).

Flowering & fruiting: January 3rd, 1917 (Igatpuri); August 1917 (Castle Rock); September 15th, 1929 (Borivli to Kanari Caves); September 22nd, 1929 (south end of Tulsi Lake); October 1917 (Igatpuri); October 1918 (Devarayi, Lohogahad Fort); October 1919 (Gersoppa Falls, Sampkhand); October 1920 (Panchgani); October 10th, 1884 (Yellapur); October 16th, 1893 (Marval); October 20th, 1905 (Mahableshwar); November 1916 (Khandala); November 1918 (Borivli to Kanari Caves).

Field notes: Purely a monsoon species, though perennial when inhabiting the rocky and sandy beds of streams and watercourses. Commences to flower

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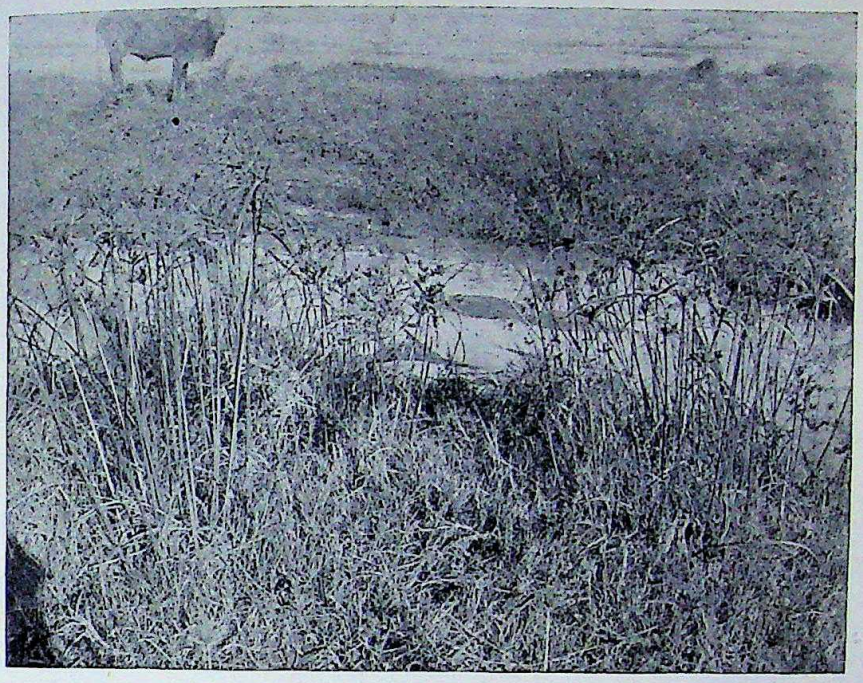
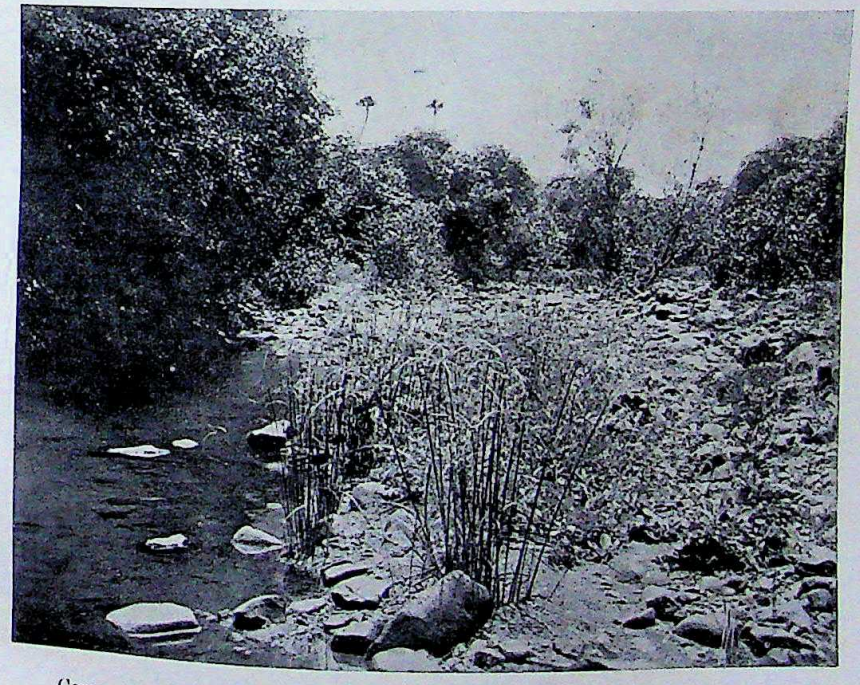


Formation of *Cyperus cleusinoides* Kunth on the banks of Benas River, Abu Road.



Common habitat of *Cyperus corymbosus* Rottb., Borivli to Kanari Caves, Salsette Island.

Photos by C. McCann.

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about the end of August. Dies down soon after the monsoon. This perhaps explains the supposed rarity.

The inflorescence in the young state is erect and much unlike the mature umbel which is much diffused with the ends pendulous by the weight of the seed (?). The spikelets are quite brown, becoming reddish when dry in the field and sometimes in the herbarium. Young spikelets in open situations, in the sun, are reddish. Stem 3-gonous, polished.

A species almost confined to rocky, stony and sandy localities, usually in forest. The mature plant is readily distinguished in the field by its enormous umbel (too large for the size of the plant !), drooping extremities and small glumes.

Distribution: More or less throughout India.—Ceylon, China, tropical Africa.

23. **Cyperus eleusinoides** Kunth Enum. ii (1837) 39; Cke. ii, 868.—*C. nutans* Vahl var. *eleusinoides* (Kunth) Haines Bot. Bihar & Orissa 898.

Description: Cke. l.c.

Plant reaching 134 cm., umbel 28 cm., primary ray 22 cm., bracts of primary umbel 58 cm., margins and upper one-third scabrid on both surfaces. Leaves on margins and towards the tip scabrid.

Woodrow's Talegaon to Chinchwad specimen was identified as *C. digitatus*.

Locality: Without locality (Dalzell !).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: Banks of Watrak River, Modasa Petha (Sedgwick 1061 !); nala near the Bokh, Prantij (Sedgwick 251 !).—*Khandesh*: Amalner, Bori River (Blatter & Hallberg 1969 !); Andra, Bori River (Blatter & Hallberg 2760 !).—*W. Ghats*: Panchgani, watercourse (Blatter C155 !, Fernandez C156 !, Blatter & Hallberg B1749 !), below Tata's (Blatter 2000 !); Katraj, tank (Bhide 939 !); Pasarni Ghat, soft soil of watercourse (McCann 3038 !); Khandala (Blatter, Hallberg & McCann 3048 !, McCann 3187 ! 3188 !), tank (Blatter & McCann 3156 !).—*Deccan*: Gangapur, Nasik (Blatter & Hallberg 2340 !); Talegaon (Blatter 3133 !); Ganeshkhind Gardens, Poona (Garade !, Patwardhan !); Bopodi, near Poona (Gammie 15317 !); Talegaon to Chinchwad (Woodrow !); Mawal (Woodrow ex Cooke); Happy Valley (H.E.B.B. !); Digras, Ahmednagar Dist. (Herb. Sedgwick 6266 !).—*Konkan*: (Lambert ex Cooke).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 80 in. (Sedgwick 4121 !); Dharwar, in a nala, 2,400 ft., rainfall 34 in. (Sedgwick 2881 !); Bidi, Belgaum Dist., 2,500 ft., rainfall 60 in. (Sedgwick 3022 !).

Flowering & fruiting: March 1917 (Khandala); March 31st, 1929 (Khandala); May 1917 (Khandala); June 1905 (Ganeshkhind); July 1916 (Khandala); July 1918 (Devarayi); August 1911 (Digras); August 1914 (Prantij); August 10th, 1905 (Ganeshkhind); August 18th, 1902 (Bopodi); August 20th, 1903 (Ganeshkhind); September (Talegaon); September 1915 (Watrak River); September 1917 (Gangapur, Dharwar, Bidi); September 3rd, 1930 (Pasarni Ghat); September 5th, 1929 (Panchgani); September 19th, 1902 (Katraj, tank); September 27th, 1895 (Talegaon to Chinchwad); October 1908 (Panchgani); November 23rd, 1929 (Panchgani); December 1916 (Amalner, Amda); December 21st, 1907 (Happy Valley).

Field notes: A monsoon plant on the whole, but may be found at any time of the year in marshes and on the banks of rivers. Always to be found partially in or near water along the banks of rivers, streams and tanks. It is best in flower just before the rains give over and immediately after.

A good species easily recognizable both in the field and in the herbarium. The leaves and stems are highly polished.

The distribution is rather curious. Though a very common plant in the Presidency it apparently prefers the drier portions, not being found in N. Kanara. When in very dry situations it dies down very rapidly after the monsoon; this may possibly explain its absence from Cutch and Kathiawar.

In Rajputana (Abu Road) we have observed this species growing on the banks of the Benas River in close formation covering a considerable area associated with the Northern form of *Pycreus globosus* Nees. Here it attained a height of a little over 60 cm. with ridged culms.

In Panchgani specimens were found growing in a water hole (an old tank built in) deeper than the height of a man (in some places). Here these plants reached extraordinary proportions with regard to height, size of umbel and length of bracts.

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Distribution: Sind, Gujarat, Khandesh, Deccan, Konkan, S. M. Country, and all E. and Central districts of the Madras Pres., Nilgiris, Pulney and Travancore Hills, Punjab, Upper Gangetic Plain, Ranchi, Naga Hills.—Ceylon, tropical and warmer parts of Asia, Africa and Australia.

24. **Cyperus pilosus** Vahl Enum. ii, 354.—*C. marginellus* Nees in Wight Contrib. 83.—Synonyms in F.B.I. vi, 609.

Description: Glabrous, except the rhachis of spikes. Stolons scarcely 1.25 mm. diam., with distant nodes and scales 6-8 mm. long, easily overlooked when young as roots, but afterwards thickening somewhat into a wiry rhizome. Stems at top acutely triquetrous, from 0.9 m. with umbel 40 cm. across, to 10 cm. with umbel reduced to 1 head. Secondary umbel closely corymbed. Leaves often $\frac{3}{4}$ length of stem, 5-8 mm. broad; bracts overtopping umbel, leaf-like. Rhachis of spikes in most examples definitely pilose, often only more or less scabrous subpilose, in the form *marginellus* microscopically glabrous. Spikelets (commonly) 10 by 2 mm., linear, 10-20-flowered, compressed, reddish or brown or straw-coloured, close or remote, when ripe spreading at right angles; rhacheola obscurely (or not) winged. Glumes ovate, muticous, scarcely keeled, 3-7-nerved on back, ultimately loosely imbricated. Stamens 3; anthers linear-oblong, muticous. Nut acutely trigonous, ellipsoid, apiculate, 3/5 length of the glume, black; style shorter than nut; branches linear, moderately exserted.

We see no good line of demarcation between this species and *C. procerus* Rottb. The rhachis of the inflorescence is pilose to varying degrees. In this matter we find that we are in agreement with the views of Boeckeler. We certainly cannot separate the two species.

Leaves and bracts scabrid throughout on both surfaces. The margins leaving a sharp cutting edge when the finger is rubbed from tip to base. Margins of glumes distinctly hyaline.

Locality: *W. Ghats*: Panchgani, in a marsh near a stream (McCann 3172 ! 3194 !, Fernandez C200 ! C201 ! C202 ! C206 !).—*Konkan*: Foot of hill W. of Mulland, in a stream (McCann 1632 ! 1633 !); Bhandup (Blatter & McCann 2416 !); near Vehar Lake (McCann 649 ! 650 ! 1285 ! 1286 !); Vetora (Sabnis 33763 !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4483 !).—*N. Kanara*: (Bell 4447 !); marshes near Nagagati, 1,800 ft., rainfall 90 in. (Sedgwick 2915 !); Sampkhand (Hallberg & McCann C105 ! C116 !).

Flowering & fruiting: April 27th, 1930 (Hills W. of Mulland); June 1917 (Bhandup); July 7th, 1929 (Vehar Lake); September 19th, 1930 (Panchgani); September 22nd, 1929 (Vehar Lake); October 1918 (Kanara, Devarayi); November 23rd, 1929 (Panchgani).

Field notes: A monsoon species to a certain extent; but it may be found at any time of the year on the banks of streams or otherwise near water. The stems are sharply triquetrous. The inflorescence is very characteristic being frequently straw-coloured or reddish. The rays and spikelets are very stiff. The long creeping stolons are covered at intervals with bluish purple scales.

Distribution: Throughout India from sea-level to 5,000 ft.—Tropical Asia, Africa and Australia.

Var. obliqua Clarke in Journ. Linn. Soc. xxi, 151.—*C. obliquus* Nees in Wight Contrib. 86.

Description: Spikelets with fewer, sometimes only 5-6 flowers, often pale and very far apart.

Locality: *N. Kanara*: Yellapur (Talbot 987 !).

Flowering & fruiting: September 15th, 1884 (Yellapur).

Distribution: Widely scattered in India.—Java.

25. **Cyperus procerus** Rottb. Descrip. *et* Ic. (1773) 29, t. 5, fig. 3; Cke. ii, 867.—Synonyms in F.B.I. vi, 610.

Description: Cke. l.c.

Locality: *Goa*: (Woodrow ex Cooke).—*S. M. Country*: Dastikop, small tank, 1,800 ft., 35 in. rainfall (Sedgwick 3790 !); Shiggaon, 2,000 ft., rainfall 33 in. (Sedgwick 2129 !); Devikop, 2,000 ft., rainfall 45 in. (Sedgwick 2972 !).

Distribution: More or less throughout India.—Ceylon, Tonkin, Java.

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26. **Cyperus malaccensis** Lam. Illustr. i (1791) 146; Cke. ii, 869.—*C. Pangorii* Roxb. Hort. Beng. (1814) 6.—Synonyms in F.B.I. vi, 608.

Description: Cke. ii, 869.

The Keti specimen D719 was determined as *Cyperus tegetum* Roxb. in the Fl. Indus Delta by B. N. Vakil.

Locality: *Sind*: (Pinwill ex Cooke); Keti (Blatter & McCann D719 !).—*Konkan*: Kalyan (Woodrow ex Cooke).—*Goa*: (Woodrow ex Cooke).—*N. Kanara*: Mirjan (Sedgwick 6814 !, Hallberg & McCann C192 !).

Flowering & fruiting: October 1919 (Mirjan); October 1922 (Keti).

Field notes: A species of salt marshes where the marshes are not too salt—generally in the mouths of rivers under tidal influence.

Uses: 'A large glabrous sedge, useful for binding and protecting muddy river banks' (Prain, Fl. Sundribuns, Rec. Bot. Sur. Ind. vol. ii, p. 351).

Distribution: Sind, Konkan, N. Kanara, Quilon, Bengal to Singapore, Circars ?—Japan, China, Borneo, Australia, Persia.

27. **Cyperus bulbosus** Vahl Enum. ii (1806) 342; Cke. ii, 871.—*C. jeminicus* Retz. Obs. iv (1786) 11.—Synonyms in F.B.I. vi, 611.

Description: Cke. l.c.

The Mirpur Sakro and Gholam specimens were determined as *C. Haspan* in the Fl. Indus Delta by B. N. Vakil. *C. Haspan* is a heavy rainfall species and is not likely to occur in Sind.

Locality: Sandy shores near the sea (Dalzell & Gibson ex Cooke).—*Sind*: (Herb. St. X.C. 1971 !); Mirpur Sakro (Blatter & McCann D713 ! D714 !); Gholam (Blatter & McCann D715 ! D716 ! D717 !); Hyderabad (Woodrow ex Cooke); Jamadar ka Landa, near Karachi (Stocks ex Cooke).—*Cutch*: (Blatter ex J.B.N.H.S.).—*Gujarat*: Ahmedabad, fields (Sedgwick !); Vastrapur, near Ahmedabad (Saxton 1771 !).—*Deccan*: Kirkee, Mr. Gammie's compound (Garade 4 sheets 572 !).—*Konkan*: Sewri, Bombay Isl. (Blatter & McCann 1851 !); Victoria Gardens (Blatter & McCann 2392 !); Bandra, from pasture on side of Danda Rd. (Vakil C170 !).—*N. Kanara*: Karwar, sandy shore (Sedgwick 5050 !, Talbot 1262 ! 1537 !).

Flowering & fruiting: June 25th and 30th, 1885 (Karwar); July 1917 (Victoria Gardens Sewri); July 1919 (Bandra); July 21st, 1902 (Kirkee); July 27th, 1919 (Vastrapur); August 1914 (Ahmedabad); October 1922 (Gholam, Mirpur Sakro).

Uses: *Cyperus bulbosus*, called Theg (Ahmedabad) or Bid (Viramgam) 'grows in a river near Viramgam. Its bulbs are dried and powdered and used with jowari, bajri or wheat flour. It is not very nutritious, therefore it is mixed with the above flours. It grows wild and its effects are that people who use it as food become night blind.' Gammie Rec. Bot. Surv. of India, ii, 193.

Distribution: Sind, Baluchistan, Rajputana.—Ceylon, tropical Africa and Australia.

28. **Cyperus articulatus** Linn. Sp. Pl. (1753) 66; C. B. Clarke in Hook. f. F.B.I. vi, 611.—*C. nudus* Roxb. Fl. Ind. i (1832) 187 (*non* 209, *neque* H.B. & K.).

Description: Glabrous. Stolons 3-4 mm. diam., clothed by ovate-lanceolate striate brown-black scales 17 mm. long. Stems 0.9-1.8 m., often 5-10 cm. apart on the thick woody rhizome, at top 3-4 mm. diam., terete or scarcely trigonous, when dry usually with false nodes 13 mm. apart; upper sheaths usually terminated by a subspathaceous lanceolate coloured limb, rarely by a small green leaf. Leaves hardly any. Umbel compound of many spikes. Umbel-rays often 10, up to 5-15 cm.; bracts very short, 8-17 mm., ovate, acute, scale-like, striate, subturgid at base hardly keeled, concave, margins not reflexed. Spikes linear, many-flowered. Spikelets 5-15 together, shortly spicate, 8-38 by 2 mm., 12-50-flowered, straw-coloured, afterwards dusky. Glumes even in fruit imbricate, ovate, obtuse, concave, scarcely keeled, obscurely 3-5-nerved on back; wings of rhachilla oblong or elliptic, scarious, ultimately deciduous. Stamens 3; anthers linear-oblong, muticous. Nut trigonous, oblong-ellipsoid, acute at either end, 3/5 length of glume, black; style shorter than nut; branches linear, shortly exsert.

Stems hollow but traversed transversely by thin white septa.

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Locality: *Gujarat*: Ahmedabad, riverside (Sedgwick 1018 !).—*W. Ghats*: Khandala (McCann 3195 !).—*Konkan*: Varol tank, Bhivandi, near Kalyan (McCann 1682 ! 1683 ! 1720 ! 1721 !).—*S. M. Country*: Mishrikot, 1,800 ft., rainfall 30 in. (Sedgwick 3179 !); Devikop (Talbot 1062 !); Kilgerry, Dharwar Dist. (Talbot 2612 !); Dastikop (Talbot 1062 !).—*N. Kanara*: Mundgod (Talbot !).

Flowering & fruiting: February 1884 (Mundgod); April 1917 (Khandala); May 1915 (Ahmedabad); September 15th, 1891 (Kilgerry); October 26th, 1930 (Varol Tank); October 29th, 1884 (Dastikop); October 30th, 1884 (Devikop); December 1917 (Mishrikot).

Field notes: A plant of the banks of rivers and lakes. The Varol specimens were growing mixed in the same clump with *C. tegetum*, but were easily distinguished from that plant by the difference of the stems and the inflorescence. The spikes are pale straw-coloured (in *C. articulatus*) the older ones slightly tinged with brown. The entire inflorescence is very weak and all the rays hanging down. The presence of septa is not always apparent in herbarium material.

Distribution: Bengal to Ceylon.—Tropical and warm regions of both hemispheres.

29. **Cyperus corymbosus** Rottb. Descr. *et* Ic. (1773) 43, t. 7, fig. 4; C. B. Clarke in Journ. Linn. Soc. xxi, 158, and in Hook. f. F.B.I. vi, 612; Cke. ii. 870.—*C. diphyllus* Retz. Obs. v (1789) 11 (*non* Benth.); Boeck. in Linnaea xxxvi (1870) 272.—*C. Koenigii* Vahl Enum. ii (1806) 302; Kunth Enum. ii, 54.—*C. monophyllus* Vahl l.c. ii, 352 (*fide* Nees).—*C. seminudus* Roxb. Fl. Ind. i (1832) 187; Nees in Wight Contrib. 80; Kunth l.c. 55 (*non* Moritz.).—*C. enodis* Boeck. l.c. 271.—*Papyrus Pangorii* Nees l.c. 88 (*partim*).—*C. articulatus* Ridley in Trans. Linn. Soc. ser. 2, Bot. ii, 141 (*partim*).—*C. corymbosus* var. *Pangorei* C. B. Clarke l.c. 292, 159.—*C. Pangorei* Rottb. l.c. 31, t. 7, fig. 3.—*C. tegetiformis* Roxb. Hort. Beng. (1814) 6; Arn. in Wight Contrib. 89 (*in nota*); C. B. Clarke l.c.—*C. nudus* Roxb. Fl. Ind. i (1832) 209 (*non* 187 *neque* H.B.K.).—*C. bengalensis* C. Spreng Neue Entdeck. iii, 101.—*C. Gula-Methi* Roem. & Schult. Syst. ii, Mant. 125.—*C. tegetum* Roxb. Fl. Ind. i (1832) 208; C. B. Clarke l.c. (*partim*).—*C. dehiscens* Nees in Linnaea ix, 286; Kunth Enum. ii, 56 (*excl. syn.* Roxb.).—*Papyrus dehiscens* Nees in Wight Contrib. 89.—*P. Pangorei* Nees l.c. 88.—*P. corymbosus* Nees l.c. 89.

We have united *C. tegetum* Roxb. and *C. tegetiformis* with *C. corymbosus* Rottb. for the reasons given below.

Description: Stems bluntly or sharply trigonous above, spongy below, septa not or hardly visible when dry, up to 1.8 m. high. Rhizome creeping, stout, woody. Leaves reduced to sheaths or sometimes with a blade up to 15 cm. long. Bracts 3-5, linear-ensiform, shorter or longer than the inflorescence, between 7 and 65 cm. long and 5-12 mm. wide. Umbel compound; primary rays 6-15, slender, up to 15 cm. long; secondary rays terminated by spikes or corymbs of 4-16 spikelets; spikelets linear, 10-37 mm. long, glumes ovate-oblong when unfolded, obtuse or subacute, 2.5 mm. long, straw-coloured or pale reddish brown or red-brown, rhachilla of spikelets distinctly 2-winged opposite the seeds, narrow or wide, usually pale or blood red in fruit. Nut narrowly elliptic-oblong, trigonous, 1.6 mm. long, black.

We have spent much time both in the field and in the herbarium trying to find a character to separate these three species but have failed completely. Beside studying the fresh material we have also examined the material determined by C. B. Clarke in the Calcutta Herbarium.

Much stress has been laid on the length of the bracts by some authors but this is a very unreliable character in most *Cyperaceae*. Of the three 'species' *C. tegetum* is supposed to have the longest bracts, while *C. tegetiformis* rarely has the bracts half as long as the umbel, and in *C. corymbosus* the bracts are said to be rarely as long as the umbel. The term 'rarely' indicates that at times the bracts may be as long as the umbel, though these may be 'exceptional cases'. On this account some authors regard *C. tegetiformis* as a variety of or conspecific with *C. corymbosus*, and rightly so.

Cooke in the Flora of the Bomb. Pres. has the following remark under *C. tegetiformis*: 'Woodrow gives Kalyan as the habitat of the plant, but I have seen no specimen from the Bombay Presidency; there are none in Herb. Kew. It

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is possible that the plant collected by Woodrow may have been *C. corymbosus*, which is scarcely separable from *C. tegetiformis* and which is also reported from Kalyan.' Cooke has not seen either *C. corymbosus* or *C. tegetiformis*.

Sedgwick, in *The Journal of the Bombay Natural History Society*, xxv, 695, had added the following note under *C. tegetiformis*: 'Both *C. tegetiformis* and *C. corymbosus*, Rottb., are given by Cooke as occurring at Kalyan *fide* Woodrow). These two species are very imperfectly characterized, and are very probably forms of one species. Cooke doubts whether they both occur. I have placed the St. Xavier's College specimens in *tegetiformis* as the spikelets are pale, whereas the spikelets of *corymbosus* should be red. The bracts, however, are more than half the inflorescence.'

Here again we have a character, viz. colour, which is unreliable not only in dried but also in fresh specimens.

Haines, in the Botany of Bihar and Orissa, pt. v, p. 899, makes the following remark under *C. tegetiformis*: 'There is only one specimen from our area (Gaya) which has been named in the Cal. Herb. and that appears to me doubtful and is possibly *C. corymbosus*. The bracts slightly exceed the umbel and the erect spikelets are very young. Glumes ·11 in. long, back with 5 slender nerves, anthers 3 minutely apiculate, wings of rhachilla very obscure, nut undeveloped. Most of the specimens named by Clarke are from Lower and Eastern Bengal. I suspect that the length of the involucral bracts is not a good character, especially in inflorescence of different stages of growth.'

Under the species *C. corymbosus*, l.c. Haines writes: 'I have seen no ripe nuts, and suspect that some specimens ascribed to this species are young states of others and that there is no specific difference between this and *tegetiformis*. Rhizome creeping, clothed with dark brown scales and hardening into rhizomes. The new shoots are said to arise on these at some distance from one another as also in the case of *tegetiformis*, whereas in *C. tegetum* there are said to be no stolons and thus the lateral shoots arise from the base of the older ones. Herbarium material is insufficient to check these characters.'

Again, with reference to *C. tegetum*, l.c. Haines remarks: 'Rhizomes stout and in some of my specimens culms quite 1 in. apart. Sheaths much inflated when old. Leaves above the sheath 0 or 3-9 in. long. Inflorescence with long foliaceous bracts often one and a half times its length, about ·2-·3 in. wide, margins scaberulous, midrib strong. Branches of umbel 1-10 in. long suddenly contracted at the corymbs of spikes, branches and peduncles of spikes with short lanceolate finely or setaceously acuminate bracts as well as a short truncate sheath at their base. Glumes sometimes only ·06 in. long in flower. Wings of rachilla about ·04-·05 in. long, as long as the ovary and usually green in flower, ultimately red or brown. Stamens 3. Style rather persistent about ·04 in., leaving no base on falling, stigmas 3 long and slender, often ·12 in. long.

'This is a good species for observing that the wings of the rachilla form no part of the glumes (as stated to be the case by Cooke); the glumes very clearly embrace the wings and can be removed over the wings.'

Another character stressed by authors is in the wings of the rhachilla, which are supposed to be dark brown in *C. tegetum*. This is, however, the case with all the so-called species if the inflorescence is allowed to mature. We have in our collection specimens of the three 'species' with the wings of the rhachilla varying in tint from hyaline to deep brown and we have seen material in other collections exhibiting the same degree of variation. When the spikes are immature the wing of the rhachilla is hyaline, becoming dark brown as the spikes get older. Haines remarks that he has seen no ripe nuts of *C. corymbosus*, and that in the case of the one specimen of *tegetiformis* from the area the nut was undeveloped.

Though the bracts and the rhachilla are much used as a means of identifying these three 'species' we must admit that they are unreliable characters. Comparing the descriptions of the spikelets, glumes and nuts we find that there are barely any differences worthy of specific rank.

The most essential characters are thus either the same or overlapping. In the case of *tegetiformis* there are said to be 5-9 nerves to the glume but this is a very variable character in all three 'species'.

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Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Marshy ground, the Watrak riverbanks, Sabarmati river-bed, the Bokh (Saxton & Sedgwick, Pl. N. Guj. R.B.S.I. vi, 305).—*W. Ghats*: Igatpuri (Blatter & Hallberg 3211 !, McCann 2386 !); Panchgani, stream below Dalkeith (McCann 3492 !); Bairawadi, foot of Purandhar (Blatter & McCann 5578 !); Khandala, on sandy soil (McCann C117 !, Blatter, Hallberg & McCann 2420 ! 3049 !, Blatter 1856 !); Khandala to Karjat (Blatter & Hallberg 3171 !); Lonavla (Garade ex Cooke).—*Deccan*: Poona (Talbot !); Kirkee (Talbot !); Gangapur, Nasik (Blatter & Hallberg 2821 !).—*Konkan*: (Cooke); Thana (Blatter & McCann 8727 !); Trombay (Blatter & McCann 33855 !); Borivli to Kanari Caves, on sand in bed of watercourse (McCann 1103 !); in a marsh among the hills W. of Vickroli (McCann 1021 !); Mulland, in a stream (McCann 901 ! 907 ! 908 !); foot of hills W. of Mulland (McCann 906 !); hills W. of Tulsi Lake, in a stream (McCann 357a ! 357b ! 357c ! 810 !); Kalyan (Woodrow ex Cooke).—*S. M. Country*: Devarayi, 1,800 ft. (Sedgwick 4119 !); Havasbhavi, 2,000 ft., rainfall 35 in. (Sedgwick 2159 !).—*N. Kanara*: Gersoppa Falls (Hallberg & McCann C118 !, Sedgwick 7126 !); Kalanuddi, Supa, 1,800 ft., rainfall 100 in. (Sedgwick 4863 !); Haliyal (Talbot 2219 !); Kilgerry (Talbot 2613 !).

Flowering & fruiting: January 5th, 1890 (Haliyal); March 1917 (Khandala to Karjat); March 11th, 1929 (Hills W. of Mulland); July 1918 (Devarayi); August 1914 (Prantij); August 11th, 1929 (Mulland; Hills W. of Mulland); August 25th, 1929 (Hills W. of Vickroli); September 1915 (Watrak River); September 1917 (Gangapur); September 15th, 1890 (Kilgerry); September 15th, 1929 (Borivli to Kanari Caves); September 15th, 1905 (Kirkee); October 1890 (Poona); October 1917 (Igatpuri); October 1919 (Gersoppa Falls); November 1918 (Supa); December 1914 (Watrak River); December 1916 (Havasbhavi).

Field notes: A tall perennial species with thick hard, black, creeping rhizomes, the anterior end of which usually sends up few short leaves before the appearance of the culm. Wherever there is water this species lasts throughout the year. The culms that flower during the monsoon loose the inflorescence with the approach of the dry weather and then die down, but if there is plenty of water these old culms remain and new ones are also developed but these hot weather culms do not reach the same size as those produced during the monsoon, nor are the inflorescences so large.

The plants developed in soft clayey soil are generally the most vigorous. The rhizomes are usually deep rooted and are difficult to extract.

The Floras give leaves short or 0 for this section. In our experience this is not the case. In specimens with mature rhizomes a few short leaves are often developed, but usually longer than the measurements given in the Floras. The leaves are developed on the new shoots of the mature rhizomes long before the inflorescence-bearing stem appears. When the culm appears the leaves fall away leaving a sheath embracing it with a short prolongation—the leaf of the Floras.

Seedlings have long fairly broad leaves (sometimes exceeding 45 cm. and more). These leaves are generally longer than those developed directly from new shoots of the rhizome. Another point worthy of note is that the inflorescence-bearing culms endure for a long time in a green state, long after the spikelets have fallen, and so do the bracts—but the culms remain longer.

The wing of the rhachilla is at first quite hyaline and gradually changes to a dark brown. In herbarium material the colour of the rhachilla depends much on the time when the inflorescence was collected and how far advanced it is.

Uses: This plant is used for the manufacture of mats.

Distribution: Throughout India.—Ceylon, China, Japan, most of tropical Asia, Africa and America, Madagascar.

30. **Cyperus macer** C. B. Clarke in Journ. Linn. Soc. xxi, 160; in Hook. f. F.B.I. vi, 613.

Description: Glabrous. Stems long, slender, 60-90 cm., at top very slender triquetrous. Leaves few, short, inconspicuous, uppermost 10-15 (rarely 20-25) cm. long, erect, narrow. Umbel loose, irregular, slender. Umbel-rays 3-6, slender, 5-10 cm. long, sometimes again divided; bracts 13-50 mm., leaf-like. Spikelets 8-16-flowered, linear, 13 by 1.5 mm.; wings of rhachilla narrow-oblong, hyaline, disappearing. Glumes somewhat remote, in fruit not imbricate,

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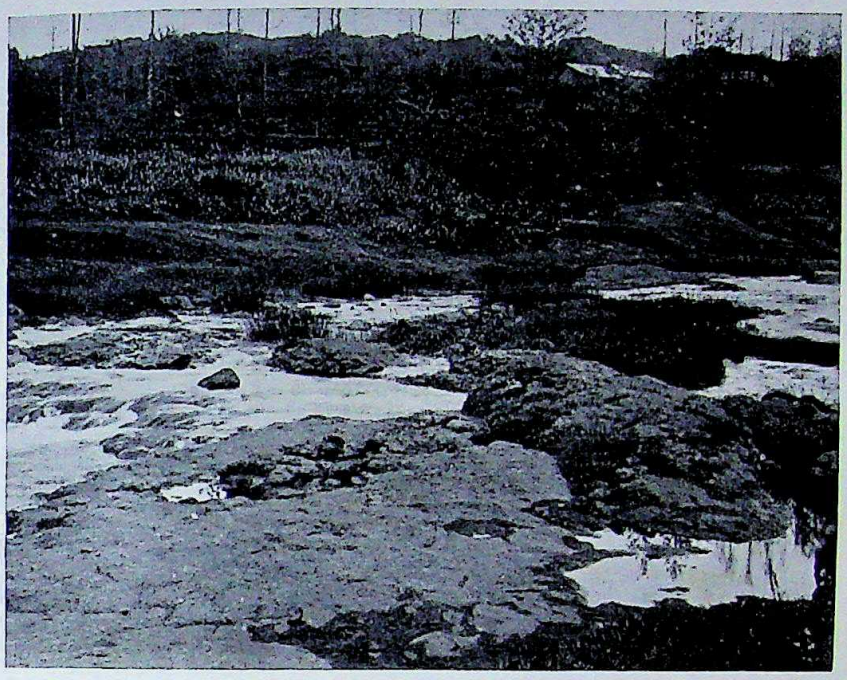
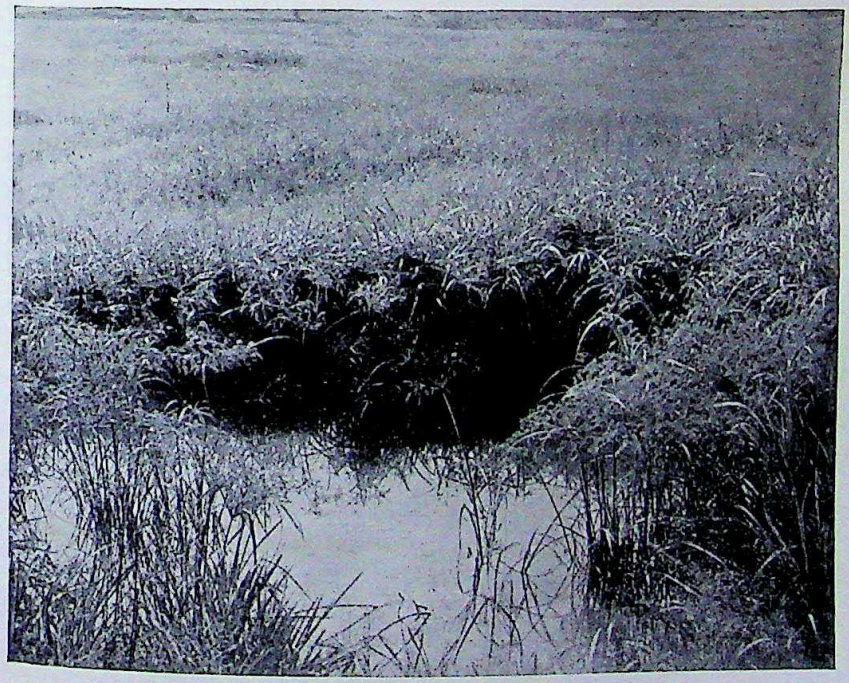


Formations of *Cyperus macer* (mid-stream) at Lingmala, near Mahableshwar.



Common habitat of *Cyperus exaltatus* Retz. in a marsh at Mulland, Salsette Island.

Photo. by C. McCann.

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ovate-oblong, obtuse, 3-5-nerved, back green, sides brown, nerveless. Stamens 3; anthers linear-oblong, muticous. Nut trigonous, obovoid, ashy black, ½-⅔ length of glume; style shorter than nut; branches linear, long.

Locality: *Gujarat*: Under Gorair Bridge, Chitrasani to Sarotra, in sandy bed of a stream, at water's edge (McCann 1375 ! 1375a !); Karad to Islampur Road (Chibber !).—*Khandesh*: Wadli, Tapti bank (Blatter & Hallberg 5491 !); Bor, Tapti River (Blatter & Hallberg 1929 ! 3014 !); Thalner, Tapti bank (Blatter & Hallberg 3021 !); N.-E. of Bhusawal, in Tapti bed (Blatter & Hallberg 2759 !).—*W. Ghats*: Panchgani, 2½ mm. W. (Blatter & Hallberg B1751 !, Fernandez C189 !); Mahableshwar in a stream on hillside, 4,500 ft., rainfall 270 in. (Sedgwick 4551 !); Lingmala, common in river (McCann 3361 ! 3382 ! 3383 !); foot of Fitzgerald Ghat, river-bed (Blatter C216 !).—*N. Kanara*: Sampkhand, in river (Sedgwick 6972 !).

Flowering & fruiting: January 3rd, 1917 (Wadli); September 24th and 27th, 1930 (Lingmala); October 1919 (Sampkhand); October 1920 (Panchgani); October 24th, 1929 (Gorair Bridge); November 1918 (Mahableshwar); November 28th, 1902 (Karad to Islampur Road); December 1916 (Bor, Thalner).

Field notes: We have several records of this species from the Presidency but are of opinion that this species was overlooked for small forms of *C. corymbosus*, and included under that species. In the field it is easily distinguished from that species, but herbarium material is somewhat difficult to determine.

It is a plant of rocky beds of rivers and also of pebbles where it forms dense mats with its roots. The Yenna River is full of this species. The dense mats of roots and rhizomes are quite different from those of *C. corymbosus*, in which case the rhizomes are very thick.

Distribution: Pegu, Chittagong, Central India, Gujarat, Khandesh, W. Ghats, Deccan, N. Kanara.

31. **Cyperus rotundus** Linn. Sp. Pl. (1753) 45; Cke. ii, 871.—*C. hexastachyus* Rottb. Descr. *et* Ic. (1773) 28, t. 14, fig. 2.—*C. leptostachyus* Griff. Itin. Notes 321 (*non* Nees).—*C. tenuiflorus* Royle Ill. 412 (*non* Rottb.).—*C. Fenzelianus* Steud. Syn. Cyp. 33.—*C. pallescens* Boiss. Fl. Or. v, 375 (*non* Desf.).—*C. subcapitatus* C. B. Clarke in Hook. f. F.B.I. vi, 616.—*C. tuberosus* Rottb. l.c. 28, t. 7, fig. 1.—For synonyms see C. B. Clarke in F.B.I. l.c.

We follow Fischer (Fl. Madras, 1641) in uniting *C. Fenzelianus*, *C. subcapitatus*, and *C. tuberosus* with *C. rotundus*. Here we have to deal only with *C. tuberosus*. Cooke already (l.c.) remarks with regard to *C. tuberosus*: 'Not distinguishable from *Cyperus rotundus* by any good characters and it might well be united with it'.

Description: Tubers not zoned. Stems subsolitary, trigonous, 0.1-1.2 m. high. Leaves flat, flaccid, shorter or longer, narrow, often numerous; bracts usually 3, shorter or more often longer than the inflorescence, up to 60 cm. long. Umbel simple or compound; rays few to many, up to 15 cm. long; secondary, if present, few, ending in 4-8 approximate, spreading spikelets; spikelets linear to lanceolate, 7.5-35 mm. long; glumes imbricate, 2.5 mm. long, plicate, ovate when expanded, obtuse or acute, keel 5-7-nerved, pale straw or brown, or chestnut, sometimes with a reddish tinge. Nut trigonous, broadly obovoid, greyish black.

The Poona specimen collected by Bhagwat is an excellent specimen with bulbils and bulbous bases to the stems but no proper inflorescence.

Possess both stolons and rhizomes (Sedgwick).

Locality: Without locality (Dalzell !).—*Sind*: (H.E.B.B. !, Bhola Puran 25 ex Cooke); Mirpur Sakro (Blatter & McCann D720-D726 !); Bohara (Blatter & McCann D727 !); Gholam (Blatter & McCann D728 !), in a garden (Blatter & McCann D729 !); Kullan Kote Lake (Blatter & McCann D730 !); Tatta (Blatter & McCann D731 ! D732 !); Bughar, on the Indus (Blatter & McCann D733 ! D734 !); Chunar (Blatter & McCann D735 !); Bhubak (Woodrow ex Cooke).—*Cutch*: (Blatter 3774 !); Pacham Isl., Rann of Cutch (Blatter 1973 !).—*Gujarat*: Surat (H.E.B.B. !, Gammie 16440 !, Woodrow !); Empress Gardens, Ahmedabad (Sedgwick 1049 !); Ahmedabad (Sedgwick !, Blatter 2166 !, Cooper !).—*Khandesh*: Bori River (Blatter & Hallberg 2750 !); Bor, Tapti River (Blatter & Hallberg 1860 ! 3011 ! 5132 !); Taner, Tapti bank (Blatter & Hallberg 5171 !); Dhulia, Thikhi tank (Chibber !).—*W. Ghats*: Lonavla (Woodrow ex Cooke, H.E.B.B. !); Khandala (Blatter, Hallberg &

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McCann 3045 ! 3066 !); Purandhar (Blatter & McCann 5569 ! C217 !); Panchgani (McCann 2983 ! 3021 !); Matheran (Woodrow ex Cooke).—*Deccan*: Ahmednagar, 1,800 ft., rainfall 24 in. (Herb. Sedgwick & Bell ' 6337 !); Poona (Woodrow ex Cooke, Jacquemont 382 ex Cooke, Bhagwat !); College Farm (Ezekiel !); Kirkee, Mr. Gammie's compound (Garade 552 !); Parvati tank (H.E.B.B. !); Deolali (Blatter & Hallberg C143 ! 2836 !).—*Konkan*: (Law ex Cooke); Bombay (McCann 469 ! 470 ! 471 ! 472 ! 714 ! 715 ! 716 ! 774 !), St. Xavier's College compound (McCann 2414 ! 2432 ! 2447 !), Victoria Gardens (Blatter & McCann 2390 ! 2393 ! 2413 !); Parel (Blatter & McCann 3074 !); Sion (Blatter & McCann 1988 ! 2374 !); Bhandup (Blatter, Hallberg & McCann 2412 !); Bhandup to Vehar Lake (McCann 644 !); E. shore of Vehar Lake (McCann 636 !); Bandra, Danda Road (Vakil C144 !); Mulland, in a marsh W. of village (McCann 892 ! 899 !); Mulgaon (Blatter & McCann 2443 !); Thana (Woodrow); Sangli, river bank (Blatter C142 !); very common throughout the Islands of Bombay and Salsette (McCann !).—*S. M. Country*: Margins of tank, Kalghatgi, 2,000 ft., rainfall 30 in. (Sedgwick 3667 !); Dharwar, rice fields, 2,400 ft., rainfall 34 in. (Sedgwick 6189 !); Yelvigi, 2,000 ft., rainfall 30 in. (Sedgwick 1914 !); Hubli (H.E.B.B. !); Kilgerry (Talbot 2625 !).

Flowering & fruiting: January 15th, 1890 (Kilgerry); January 22nd, 1925 (Sangli); June 1917 (Bombay, Bhandup, Sion); June 1919 (Bandra); June 24th, 1929 (Bombay); June 28th, 1917 (Poona); July 1914 (Ahmedabad); July 1916 (Parel); July 1917 (Mulgaon, Bombay, Khandala); July 7th, 1929 (Vehar Lake, Bhandup to Vehar Lake); July 21st, 1902 (Kirkee); July 27th, 1929 (Bombay); July 28th, 1920 (Parvati); August 1915 (Ahmedabad); August 1916 (Khandala); August 1919 (Dharwar); August 7th, 1924 (Bombay); August 11th, 1929 (Mulland); August 27th and 31st, 1930 (Panchgani); September 1917 (Devlali); September 1919 (Ahmednagar); September 2nd, 1895 (Lonavla); September 27th, 1913 (Ahmedabad); October 16th, 1906 (Hubli); October 29th, 1903 (Surat); November 1905 (Poona); November 1916 (Sion); December 1907 (Pacham Isl.); December 1916 (Taner, Bor, Bori River, Yelvigi); December 17th, 1892 (Surat); December 28th, 1907 (Dhulia).

Field notes: 'The commonest and worst weed in Gujarat' (Sedgwick).

Sedgwick rightly remarks that this is the commonest and worst weed, but not only in Gujarat. It flourishes the whole year where there is sufficient moisture, but it is most striking after the break of the rains. It is more essentially a monsoon plant. It fills up every available bit of ground whether stony, sandy or marshy.

On sandy and stony soil the plant attains its most characteristic form while in marshes it becomes much larger, with sharply 3-gonous stems and a large pendulous umbel. The leaves frequently persist throughout the year in spite of dry conditions (especially so on lawns). It is an exceptionally fast growing species. When the inflorescence is detached it soon puts forth a new one. It is a most variable plant.

Along the railway lines it is very abundant in the Islands of Bombay and Salsette. In these places we have noticed this species pass over the country in two distinct waves. With the break of the monsoon it springs up everywhere and is soon after in full bloom. This is the first wave which ends about the end of July when all the spikelets turn almost black and fall away. About a month or so later a second wave appears but this is not as strong as the first and the plants do not appear so well developed. We presume the second wave is the result of the seed of the first wave; but this we would not like to say for certain, as it may also be due to a second crop of individuals from the new shoots that are formed by the stolons.

Distribution: All warm countries.

32. **Cyperus esculentus** Linn. Sp. Pl. (1753) 67.

Description: An erect glabrous herb up to 50 cm. in height with slender subterranean stolons more or less covered with acute rather hard strongly veined scales and ending in ovoid to cylindrical edible tubers up to 2 cm. in length. Stem-base pale brown, leaf-sheaths not fibrous, stems triquetrous, smooth, finely striated. Leaf-blades shorter than the stems, linear and gradually tapering in the upper part to a fine acuminate apex, 3-5 mm. in width. Inflorescence primarily umbellate, of sessile and peduncled spikes the rays up

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to 7.5 cm. in length, primary bracts about 4, unequal, leaf-like, the longest up to 10 cm. or more. Spikes rarely exceeding 2.5 cm. and most often simple, the first glumes (or secondary bracts) of the lowest spikelets sometimes with a short narrow leafy blade. Spikelets linear, about 1.3 cm. long or shorter, 1.5 mm. wide; rhachis slender with narrow hyaline wings. The 2 lowest glumes of each spikelet linear-lanceolate, acuminate. Flowering glumes boat-shaped, with a rounded or slightly emarginate apex, 3 mm. long, 1.5 mm. in breadth when spread out, 3 lateral nerves on each side of the keel nerve. Stamens 3. Style divided to below the middle, with its 3 branches 2 mm. long. Nut obovoid-ellipsoid in outline with 3 sharp angles, 1.5 mm. long.

Locality: *Gujarat*: Edge of the tank, Talod, August 1914; never seen again, one plant only a viviparous form (Saxton & Sedgwick Pl. N. Guj. R.B.S.I. vi, 806).

This plant is now firmly established on both sides of the Colaba Road, Bombay, when it crosses over the Bombay, Baroda and Central India Railway. There also the plants are often viviparous (Saxton & Sedgwick l.c.).

Distribution: Upper Gangetic Plain, from the Ganges Plain to the Nilgiris and Anamalais.—In nearly all warm countries, especially in America.

33. **Cyperus stoloniferus** Retz. Obs. iv, 10; Nees in Wight Contrib. 81; Fischer Fl. Madras 1641.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 615.

Description: Stolons long, hardening into a long-creeping woody rhizome, not producing tunicated bulbils. Stems 10-30 cm., at top trigonous, at base nodose, wiry, often flexuous. Leaves shorter or as long, usually subulate and squarrosely recurved. Bracts 3, up to 7.5 cm. long. Umbel of 4-6 rays, sessile or with peduncles up to 30 mm. long, bearing 3-8 spreading spikelets. Spikelets ovate- or linear-oblong, hardly compressed, 6-15 mm. long; glumes densely imbricate, broadly ovate when expanded, plicate, acute, 2.5 mm. long, red, keel greenish, margins broadly hyaline, the lowest sometimes scarious. Nut obovoid, plano-convex, dorsal surface hardly keeled, dark brown.

Locality: *Sind*: (Pinwill ex Clarke).—*Cutch*: On sandy seashore (Blatter ex J.B.N.H.S.).—*Konkan*: Bombay (Jacquemont 430 ex Clarke), seashore (Herb. Sedgwick & Bell 7318 !); seaface near Mahalaxmi Battery, among rocks and gravel (McCann 358 ! 359 !); Mahim, shore (Blatter 2741 !).—*N. Kanara*: Karwar, on rocks by the sea (Sedgwick & Bell 6758 !, Hallberg & McCann C125 !), sandy seashore (Sedgwick 5050 !).

Flowering & fruiting: March 23rd, 1929 (Mahalaxmi Battery); October 1919 (Karwar); December 1915 (Mahim); December 1918 (Karwar); Bombay (December 1919).

Field notes: Essentially a maritime species. Growing among rocks, gravel and sand, usually a little below the high water mark. Stolons thick, strong, horizontal with a strong perpendicular root descending from the base of each sucker. Very difficult to extract. Inflorescence inclined to droop, pale yellowish green. Stems erect, trigonous just under the umbel. Leaves dark green, recurved.

Near Mahalaxmi Battery it forms a dense carpet often mixed with *Fimbristylis polythrichoides*.

Distribution: Shores of India, especially in sea sand.—Ceylon, Malay Peninsula, Mauritius, China, Malaya, Australia.

34. **Cyperus exaltatus** Retz. Obs. v (1789) 11; Cke. ii, 872.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 617.

Description: Cke. l.c.

Locality: *Gujarat*: Marshy banks of the Watrak River, Modasa Petha (Sedgwick 1058 !); marshy places on the Watrak River banks (Saxton & Sedgwick Pl. N. Guj. R.B.S.I. vi, 306); Sevalia, Kaira Dist. (Chibber !).—*Khandesh*: Bor, Tapti River, sandy mud (Blatter & Hallberg 3030 !); Dhulia, Thikhi tank (H.E.B.B. !); Dadgaon (Blatter, Hallberg & McCann 29586 !); Toranmal (Blatter, Hallberg & McCann 29575 !).—*W. Ghats*: Khandala, in a rivulet (Sedgwick 2572 !, Blatter 1854 !, Blatter & McCann 3165 !, Blatter, Hallberg & McCann 2410 ! 3056 !, McCann C207 !); Lonavla (Woodrow ex Cooke; Blatter, Hallberg & McCann 3148 !); Londa (Gammie !).—*Deccan*: (Dalzell & Gibson ex Cooke); Lena Hill, Nasik (Blatter & Hallberg C137 !).—*Konkan*: Dhobi Talao, Bombay (Blatter & McCann 3092 !), St. Xavier's

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College grounds (McCann 2799 !); Pen (Blatter, Hallberg & McCann 3227 !); near Budlapur (H.E.B.B. !); Mulland, in a swamp (McCann 1270 ! 1271 ! 1272 !); Sion (McCann 966 !); hills W. of Vickroli, in a swamp (McCann 1022 !); Borivli, in a ditch (McCann 1113 ! 1114 ! 1115 !); Kondita (Blatter, Hallberg & McCann 3082 !); Vehar Lake (Blatter & McCann 2753 !); Varol tank, near Bhivandi (McCann 1695 ! 1712 !); Karjat (Woodrow ex Cooke).—*S. M. Country*: Dharwar, 2,400 ft., rainfall 34 in. (Herb. Sedgwick & Bell 4977 !, Sedgwick 1858 !); Nigadi, bank of tank (Sedgwick 5709 !); Belgaum (D.F.O. !); Haveri (Talbot 2227 !); Kilgerry (Talbot 2950 !); Devikope (Talbot 1064 !), at 2,000 ft., rainfall 45 in. (Sedgwick 2971 !); Dambal, Dharwar Dist. (Dalzell ex Cooke).—*N. Kanara*: Yellapur (Talbot 1064 !); Kincholi (Talbot !).—*Bombay Pres.*: Bawli (H.E.B.B. !).

Flowering & fruiting: May 25th, 1914 (Belgaum); July 1916 (Khandala); July 1917 (Khandala); August 11th, 1929 (Mulland); August 25th, 1929 (Sion, Vickroli); September 1918 (Khandala); September 15th, 1929 (Borivli); September 27th, 1895 (near Budlapur); October 1899 (Londa); October 1905 (Khandala); October 26th, 1930 (Varol Tank); November 1896 (Bawli); November 1916 (Vehar); December 1916 (Kondita); December 1918 (Toranmal, Dadgaon); December 1919 (Lena Hill); December 3rd, 1907 (Sevalia); December 28th, 1907 (Dhulia).

Field notes: A species appearing during the monsoon. Commences to flower in July. It persists in suitable localities long after the monsoon is over, even as far as January, February—rarely till May. Otherwise it dies down soon after the rains when the marshes dry. The plant generally grows in water, in pools and marshes formed during the rains with about $\frac{2}{3}$ to $\frac{1}{3}$ of the stems submerged. The stems are densely tufted and black up to the point of the water level—3-gonous, solid, polished. The rhizomes form a dense black knotty mass with numerous black roots.

The inflorescence is at first erect but soon spreads out when fully developed. When young the spikelets are from light straw coloured to golden brown but become dark brown when mature. Stems frequently bend down with the weight (? may have been knocked down) of the umbel when fully mature, and are often submerged, in which case the spikelets become almost black but do not decompose.

A most variable species in appearance especially from the juvenile to the mature state.

Uses: This tall sedge is used for matting (Prain, Fl. Sundribuns. Rec. Bot. Surv. Ind. vol. ii, p. 351).

Distribution: All over India.—Tropical and subtropical regions.

Var. dives C. B. Clarke in Journ. Linn. Soc. xxi (1884) 187; Cke. ii, 873.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Godhra (H.E.B.B. !); Dakose, Kaira Dist. (Chibber !).—*Khandesh*: Chinchpada to Borpada, Dhulia (Chibber !); Nimb, Tapti bank (Blatter & Hallberg 4442 ! 1997 !).—*W. Ghats*: Lonavla (Talbot 4797 !); Purandhar (Blatter & McCann C135 !).—*Deccan*: Pandu, Lena Caves, Nasik (Jeuken !); Poona, Ferguson College garden, in muddy tank (Paranjpye !); Bairawadi, Purandhar (Blatter & McCann C135 !).—*S. M. Country*: Dharwar, in pools (Sedgwick 1858 ! 4977 !).

Flowering & fruiting: January 1st, 1908 (Chinchpada to Borpada); March 12th. 1905 (Nasik); November 8th, 1911 (Ferguson College); December 1916 (Nimb); December 1917 (Bairawadi); December 5th, 1907 (Godhra).

Field notes: This variety, in our opinion, should be classed as a variety of *C. radiatus* Vahl which it more closely resembles. There is also another point in common between this and the true *C. radiatus* Vahl, and that is an exudation of a resinous secretion from the margins of the glumes, which is not produced by *C. exaltatus* Retz. This point has so far been overlooked, possibly owing to the secretion being mistaken for the gum used for pasting the specimens on the sheets. The exudation was first observed by us in the field and was later confirmed by herbarium material. The general colour of the inflorescence of this variety is yellowish green, turning yellowish later and eventually a light brown. The young portions of the spikelets are at first green, then yellowish and finally light brown.

The habit is much like that of *C. radiatus*, in marshes on the banks of

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pools and in pools themselves. Often in water ½ of the way up the stem. The plants (at least those from the N. of the Presidency) are generally much larger and of a paler green in general tone. The spikes are frequently longer than those of *C. exaltatus* and more flexuous. The secretion from the margin of the glumes seems to us to be a good character. It frequently flakes off in old herbarium material leaving the glumes as though highly polished.

Distribution: Bombay Presidency, Bengal, Chittagong.—Africa.

35. **Cyperus digitatus** Roxb. Hort. Beng. (1814) 81; Cke. ii, 873.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 618.

Description: Cke. l.c.

Locality: *Bombay Pres.*: Ambowne, rice fields (Gammie 15995 !).—*W. Ghats*: Khandala, in a rivulet (Sedgwick 2572 !), soldiers' playground, water-course (Blatter & McCann 2401 !, McCann C219 !); Lonavla (Woodrow ex Cooke, Paranjpye !), along river (Chibber !, Gammie 15493 ! young state, Blatter, Hallberg & McCann 28001 ! 28233 !); Panchgani, 3rd Tableland, W. face (Fernandez 203 ! 204 ! 205 !); Panchgani to Mahableshwar, in a rocky nulla (Blatter C199 !); Londa (Cooke).—*Deccan*: Poona (Woodrow 204 ex Cooke), Ganeshkhind Gardens (Garade ! young state).—*Konkan*: (Law ex Cooke); Satiwali, Bassein (Ryan 1181 !).—*S. M. Country*: Dharwar, 2,400 ft., rainfall 34 in. (Sedgwick & Bell 4978 !); Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4467 !).—*N. Kanara*: Arbail Ghat, 1,500 ft., rainfall 300 in., water hole (Sedgwick 6581 !).

Flowering & fruiting: June 13th, 1902 (Ganeshkhind); August 10th, 1903 (Satiwali); September 12th, 1895, September 22nd, 1902, September 29th, 1914, October 1918, October 7th, 1907 and November 1918 (Lonavla); November 12th, 1929 (Panchgani to Mahableshwar); November 26th, 1929 (Panchgani).

Distribution: From the Punjab to Ceylon, Assam and Penang.—S.-E. Asia, Australia, tropical Africa, Madagascar, throughout the warmer parts of America.

(*To be continued*).

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STALKING A HERD OF SAING.[1]

(Good Sport with a Camera in Burma.)

BY

E. H. PEACOCK.

(*With* 3 *plates*).

An exasperated sportsman once recorded that the intelligence of an old *saing* bull was so much greater than that of all other game that he was capable of any feat of cunning except, perhaps, walking backwards with a view to confusing those who might be following his tracks!

The big game hunter is concerned only with the old bulls. If he has had a fair measure of experience he will waste no time in 'still-hunting' for these wild oxen. As he traverses the forests his eyes are on the ground, seeking always for the fresh tracks of an indubitably old warrantable bull.

When he finds such tracks he must follow them along the hard and tortuous course that those tracks will inevitably lead him. Too often the end of that trail is marked by a sharp snort, the crash of a heavy body breaking through cover and a glimpse, perhaps, of something red and white vanishing quickly through the green maze of the forest.

This experience is so terribly common. The young bulls and cows do not possess in so marked a degree that uncanny sixth sense of danger with which the old bull disconcerts his pursuers.

'CAUGHT' THROUGH HIS LADY FRIENDS.

The best of the old bulls generally prefer a solitary life. Occasionally, however, they will join herds and, in that state, they may be led by their lady friends into situations which they would avoid in their solitary condition. The 'leary' look in the eye of the bull photographed at a 'lick' in a northern game sanctuary indicates plainly that it was entirely foreign to his nature to be caught out in so childish a fashion.

This was a case of 'lick' photography, entailing a good deal of patience, it is true, but a sedentary occupation, nevertheless, and having small relationship to the labour and woodcraft involved in the more virile sport of getting alongside a truly warrantable head with a rifle. 'Still-hunting' with a camera for herds of *saing*, however, is pure pleasure, and respectable sport withal, even to the mind of the conservative big game hunter who scorns 'licks' and water-holes and allied places and means of obtaining easy sport.

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A herd of Saing (*Bibos banteng*, Lyd.) in a typical Burmese *lwin* : the master-bull of the herd is seen on the left of the picture.

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An old bull Saing (*Bibos banteng*, Lyd.) photographed at a 'lick' in a Northern Burma Game Sanctuary.

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When the annual ground fires of March and April have cleared the heavy undergrowth from the woods and burnt the long rank grass in the clearings, it is pure delight to 'still-hunt' for *saing* in the fresh rainswept mornings and evenings of the early monsoons. It is a different proposition to tracking down the bull of one's choice, and it lacks the strained, half-savage climax when the rifle connects with its game; but it is even greater fun than lying in wait at a 'lick' for such game as may chance to walk up to the camera.

Two of the other photographs here reproduced were the reward of a day spent in 'still-hunting' with a camera. A terribly wet day in May brought us no luck in the forenoon, and despite our strongest imprecations the rain clouds continued to blot out the sun, while the ceaseless drizzle of rain lent a most dreary appearance to the *lwins* and took all the heart out of us, keen as we were. A couple of hours before sundown my patience was completely worn away.

'I've had enough of this so-and-so weather,' I said to my companion. 'I'm going back to camp.'

But when we were well inclined to the homeward route the clouds fell away and the tree-tops above us were splashed with gold. The camera hunter is, of course, first cousin to the sun-worshipper—and what a worthy object of worship it is, to be sure, after a long day of tramping through sodden woods! We gave thanks and bent our line towards a clearing where we might take unawares a sambur or a barking deer.

When we reached this *lwin* of short new grass, half of it was ablaze with sunlight, so that we must keep to the shadowed side and stalk slowly along the skirts of the forest. For a while we saw no game, but on turning a bend in the line of woods I saw, to my delight, a small herd of *saing* feeding near the edge of the forest in a light-flooded bay of the clearing.

They were grazing in ankle-short grass, and their bright red and white bodies presented a wonderful splash of colour against the sombre woods behind them.

I could not stalk this herd by following the line of woods on our side of the *lwin* because the wind was blowing from that side. Neither could I circle right round the clearing and come up-wind to them, because it would have consumed more time than the sinking sun would have allowed us.

My only hope of obtaining a picture before the sun went down lay in a direct crawl of about 150 yds. to the cover of some small bushes growing right out on the *lwin* and within about 80 yds. of the herd.

When Kipling's Mowgli conducted his man through the 'hundred agonies of a jungle stalk' he had, at most, only a solid rifle to lug along—my delicate camera with its 5 ft. long tripod legs created a few additional agonies.

It was a case of 'lie flat when their heads are up and move on when their heads are down; and no dawdling on the way in case the light fails.' But eventually I reached a bush about 4 ft. high, behind which I sat down and straddled the tripod legs about me, raising the lens very slowly above the level of the bush.

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Cautious Approach.

When this had been done I raised my head to the level of the camera, quite resigned to the possibility of the animals having detected me in the uncanny way they often do: but they were all there, and a minute later I had made my first exposures, using the very small aperture and correspondingly long exposure necessary to obtain the clear definition required for a fair enlargement of a long-range photo.

Eighty yards, however, is a very long range for a photograph, so, after making a number of careful exposures, I decided to see how much closer I could approach. Stepping clear of the bush when their heads were down and holding the camera and extended tripod before me I merely walked slowly towards them, standing still at the first sign of a lifting head. I covered fully 30 yds. in this manner, and made two exposures before I was seen.

Even so, I was not detected in actual movement, and the *saing* could make nothing out of the queer object with three thin legs and two fat ones which had suddenly appeared within their vision. So they clumped together and stared in astonishment, while I made the last exposure of the evening.

What a pity it is that there is no way of developing and printing one's negatives within a few minutes of making an exposure. The climax in the dark-room—after one has returned to a stuffy tent, seen the objectionable features of one's mail-runner, and delved into his large green bag of official correspondence—is too long delayed for any but an exceptionally cold-blooded nature.

Compensations.

But there are compensations, one supposes. I recollect walking home many miles one day in a very exalted frame of mind in the certitude that I had achieved a priceless photograph of a sambur herd containing two fine stags.

The climax—I shall never forget it—was the realisation that I had committed the ghastly blunder of making two exposures—two perfectly good exposures—on one plate!

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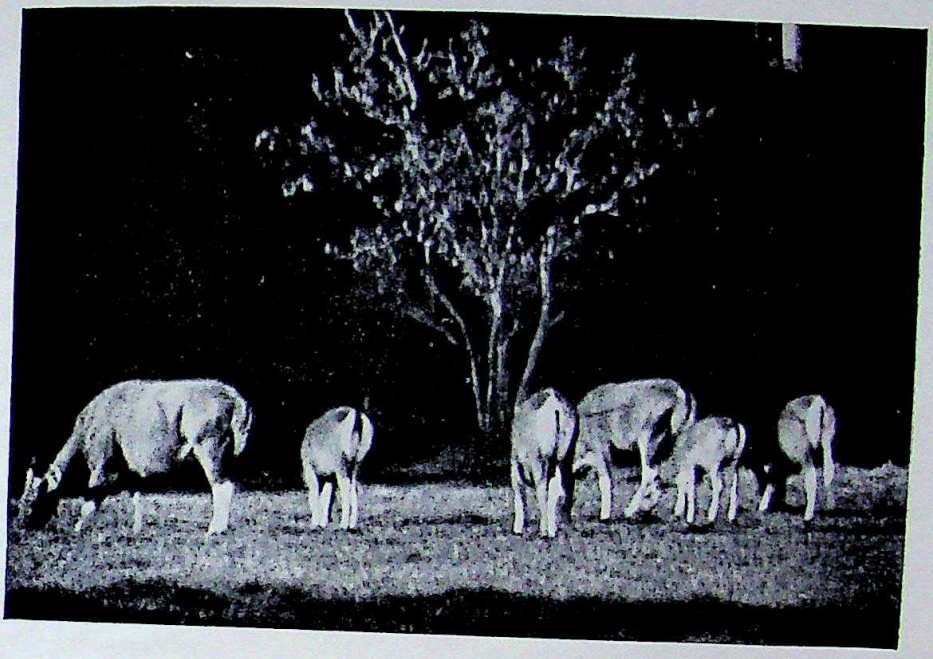
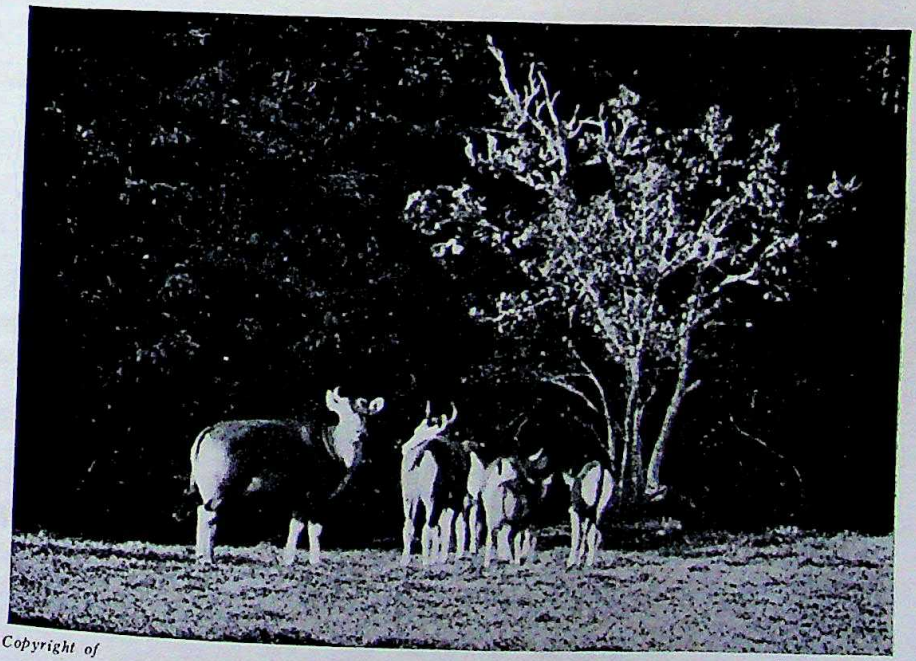


A small herd of Saing (*Bibos banteng*, Lyd.) feeding in a light-flooded bay of the *Iwin*.



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"They clumped together and stared with astonishment."

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THE VERNAY SCIENTIFIC SURVEY OF THE EASTERN GHATS.
(ORNITHOLOGICAL SECTION).

BY

HUGH WHISTLER, M.B.O.U., ASSISTED BY N. B. KINNEAR, M.B.O.U.

PART VIII.

(*Continued from page* 105 *of this volume*).

Zosterops palpebrosa salimalii Whistler.

Zosterops palpebrosa salimalii Whistler, J.B.N.H.S., xxxvi, (15 December, 1933), p. 811—Ferahabad 2,688 ft., S.-E. Hyderabad.

Specimens collected:—197-199 ♂♀♀ 11-5-29, 257 ♀ 258 ♂ 260-261 ♂♂ 21-5-29 Shevaroy Hills 3,500-4,800 ft.; 402 ♂ 13-6-29 Chitteri range 3,000 ft.; 843 ♀ juv. 28-9-29, 848 ♀ 29-9-29 Seschachalam Hills 2,000 ft.; 943-946 ♂ juv., ♀♂♂ 31-10-29, 961-962 ♂o? 3-11-29, 968 ♀ 4-11-29, 1011 ♂ 16-11-29 Nallamallai Range 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
10 ♂	11.5-12	53-57.5	37.5-40	14-15.5 mm.
6 ♀	11-12.5	51.5-55.5	35.5-39	14-15 mm.

Our information about the Common White-eye on the eastern side of the Presidency below the Godavery is confined to the above series of specimens and LaPersonne's note that he found it very common in the Shevaroy and Chitteri ranges where it is known to the Planters as the White-eyed Tit. On the Shevaroys they were particularly partial to the Silver Oak-trees. From the notes on the labels regarding the organs they appear to have been breeding in May.

Students of this difficult group will remember that Stuart-Baker (*New Fauna*, vol. iii, p. 358 *et seq.*) and Ticehurst (Bull. B.O.C., xlvii, February 1927 and J.B.N.H.S., xxxii, p. 354) have come to very different views as regards the Indian races of *Zosterops palpebrosa*. My own investigations corroborate those of Ticehurst and as he has gone into the matter in considerable detail there is no need for me to reopen the subject here.

Zosterops palpebrosa occidentis Ticehurst.

Zosterops palpebrosa occidentis Ticehurst, Bull. B.O.C., vol. xlvii, no. cccxii (February 1927), p. 88—Simla.

Specimens collected:—1336 ♂ 6-2-30, 1415 ♂ 20-2-30, 1427 ♂ 22-2-30, 1431 o? 23-2-30 Anantagiri, 3,000 ft.; 1484 ♂ 6-3-30, 1498-1500 ♀♂♂ 8-3-30, 1517 ♂ 11-3-30, 1576 ♂ 20-2-30, 1598 ♂ 24-3-30, 1601 ♀ 26-3-30, 1652 ♀ 3-4-30, 1673 ♂ 12-4-30, Sankrametta 3,000-3,800 ft.; 1702 ♂ 19-4-30 Jeypore Agency 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
11 ♂	12-13	54-57	38.5-42	15-16.5 mm.
3 ♀	12	54-55	39-41	15-15.5 mm.

Mr. LaPersonne says that in the Vizagapatam district the White-eyes were extremely common all over the hills both in forest and open country. They

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were in flocks in May though the organs of the specimens suggest that they were then breeding.

I cannot separate the above series of White-eyes from the North-Western form which Ticehurst has already shown occurs in the Central Provinces as far east as Raipur.

Zosterops palpebrosa nilgiriensis Ticehurst, Bull. B.O.C., vol. xlvii, no. cccxii (February 1927), p. 88—Coonoor.

This dark large-billed race of the White-eye is confined to the west of the Presidency. Betts says that it is common in Coorg. William Davison considered it rare in the low country of the Wynaad, but it grows increasingly common as the country rises and it is very abundant in the higher ranges of the Nilgiris. It is very common in the Nelliampathies, the Palnis and throughout the hill range of Travancore from north to south from 1,000 ft. upwards.

The breeding season appears to be from March till May.

[The reported occurrence of *Zosterops ceylonensis* at Coonoor on 5 June, 1903 (Hatchwell, J.B.N.H.S., xv, 726), must certainly be due to wrong identification.]

[Aethopyga siparaja vigorsii (Sykes).

Cinnyris vigorsii, Sykes, P.Z.S. 1832 (July 31), p. 98—Dense woods of the Ghauts.

The *New Fauna* (vol. iii, p. 382) is wrong in stating that Vigor's Yellow-backed Sunbird occurs on the west coast of India from Bombay to Travancore. It does not occur in the Madras Presidency and there appears to be no record from below the South Konkan.].

Cinnyris lotenia (Linnaeus).

Certhia lotenia Linnaeus, Syst. Nat., ed. xii (1766), p. 188—Ceylon.

Specimens collected:—21 ♀ 11-4-29, 83 ♀ 85 ♂ 19-4-29, 151 ♂ 29-4-29 Kurumbapatti; 1037 ♂ 25-11-29 Nallamallai Range 2,500 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	25-27.5	57	37-38	15-15.5 mm.
3 ♀	25.5-28	53-53.5	33-35	14.5-16 mm.

The above specimen from the Nallamallai Range extends the known distribution of Loten's Sunbird which on the east side of India has hitherto not been recorded north of Madras where it is very common. On this side in addition to the Survey specimens it occurs at Salem, Pondicherry and Trichinopoly, from all of which places there are specimens in the British Museum, and it is probably generally distributed down to Cape Comorin as a single specimen (in the British Museum) was seen and obtained by Fairbank at the eastern base of the Palnis while Ferguson says that it is common in the low country of Travancore, ascending the hills to 2,000 ft.

In the north-west of the Presidency it is evidently general and common. It has been recorded or obtained at Tellicherry (Jerdon), Calicut (Dr. Day), Coorg (Tweeddale collection), the Wynaad (where William Davison found it generally distributed) and the Nilgiris where it occurs on the slopes up to 5,000 ft. or rather more (William Davison).

Dewar says that the breeding season at Madras is in February and March.

Indian and Cinghalese birds are not separable. I have seen no evidence that Loten's Sunbird sheds the brilliant male plumage in winter[1] and I have seen specimens in that plumage in every month except July, August and December. William Davison (S.F., x, 362) and Dewar (J.B.N.H.S., xvii, 540) held opposite views on the point. The *New Fauna* fails to make clear the proportionately large size of the beak. It gives the culmen as measuring 16 to 19 mm., whereas in the five Survey specimens it measures from the feathers 22.5-25 mm.

[1] Dr. C. B. Ticehurst informs me that he has seen specimens moulting from the metallic plumage to metallic plumage from September to November, i.e. definite evidence that there is no eclipse winter plumage.

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Cinnyris asiatica astiatica (Latham).

Certhia asiatica Latham, Index Orn., vol. i (1790), p. 288—India.

Specimens collected:—320 ♀ 3-6-29 Chitteri Range 2,000 ft.; 540 ♀ 17-7-29 Gingee; 843 [♂] 28-9-29, 879 ♂ 5-10-29 Seschachalam Hills 2,000 ft.; 1162 ♂ 23-12-29, 1180 ♂ 27-12-29 Cumbum Valley; 1351 ♂ 8-2-30, 1360 ♂ 9-2-30, 1395 ♂ 16-2-30, 1709 ♀ 4-5-30 Anantagiri 3,000 ft.; 1501 ♂ 8-3-30, 1669 ♂ 6-4-30 1521 ♀ 11-3-30 Sankrametta 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
9 ♂	20-21	55-59	33.5-36	14-14.5 mm.
4 ♀	19.5-21	52-53.5	29-34	13.5-14 mm.

The Purple Sunbird appears to be very generally distributed all down the eastern side of the Presidency, occurring in the hills up to at least 3,000 ft., especially in the Vizagapatam area where LaPersonne found it very common. About Madras itself it is said to be numerically less abundant than Loten's Sunbird. On the west it is evidently more patchy in distribution, with some curious anomalies. In the Wynaad and at the foot of the Nilgiris William Davison says that it is entirely replaced by Loten's Sunbird, though according to Jerdon—and Mr. Betts confirms this—it occurs in the Nilgiris at all higher elevations up to 7,500 ft. In the Palnis and the Travancore Hills, on the other hand, Fairbank and Ferguson say that it is not found except around their bases. In the Presidency this Sunbird is a resident.

In the Nilgiris, Miss Cockburn gives the breeding season as January. Rhodes Morgan gives the breeding season for the Presidency generally as from February to June, most nests being constructed in March and April.

Ticehurst has already shown that the north-western race *brevirostris* has a seasonal change of plumage (J.B.N.H.S., xxvi, p. 286 and Ibis 1923, p. 24). This is the case also with the typical race in the Presidency. The complete postnuptial moult takes place between the beginning of July and early October and the non-metallic plumage—easily distinguished from the immature plumage, in which the male and female are alike, by the dark wings, and from its short period of retention meriting the name of 'eclipse' rather than winter plumage—is shed again in November to December by a complete body moult. The shortness of this eclipse explains the divergence of opinion as to its existence.

Birds from Ceylon are not separable.

Cinnyris minima Sykes.

Cinnyris minima Sykes, P.Z.S. 1832 (July 1), p. 99—Dense woods of the Ghauts.

The range of the Small Sunbird lies outside the area covered by the Survey. It is confined in the Presidency to the western side and there is as yet only recorded from the hill areas. It occurs throughout the Wynaad and the Nilgiris being most abundant and the commonest of the genus at high altitudes, especially on the plateau. In the Palnis it is common from 4,000 ft. to the summit (Fairbank). In Travancore it is common on the High Range and at all elevations in the hills of the south (Ferguson).

Mr. Betts informs me that the breeding season in the Nilgiris is in March and April and again in September. William Davison says that it breeds there in September and early October. In Travancore the breeding season is variously given as December to January (Ferguson) and February to April (Stuart Baker).

This Sunbird appears to have a seasonal change of plumage. I have only seen fully iridescent males from August to April and specimens dated in May and June are in a plumage similar to that of the female except that the lower back, rump and upper tail-coverts retain their iridescent colours. This postnuptial eclipse is also noted by Fairbank (S.F., iv, 256) and Davison (S.F., x, 362).

Nectarinia minima Tickell [J.A.S.B., vol. ii, 1833 (after November), pp. 569-582], described as common in Sal Jungle in Borabhum and Dholbhum of

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course cannot be this species. The description is very poor but it evidently provides an overlooked synonym for *Cinnyris asiatica*.

Cinnyris zeylonica (Linnaeus).

Certhia zeylonica Linnaeus, Syst. Nat., ed. xii, vol. i (1766), p. 188—Ceylon.

Specimens collected:—20 ♂ 11-4-29, 67 ♂ 16-4-29, 146 ♂ 28-4-29 176 ♀ 3-5-29 Kurumbapatti; 296 ♀ juv. 20-5-29, 318-319 ♀♀ juvs. 3-6-29, 355 ♂ imm. 7-6-29 Chitteri Range 2,000 ft.; 507 ♀ juv. 4-7-29 Kalai, Trichinopoly; 562 ♀ 19-7-29, 567 ♂ 20-7-29 Gingee; 705 ♂ 18-8-29 Palkonda Hills 1,000 ft.; 776 ♀ 31-9-29 Kodur; 866 ♀ 3-10-29, 896 ♂ 10-10-29 Seschachalam Hills 2,000 ft.; 986 ♂ 9-11-29, 1013 ♂ 16-11-29, 1036 ♂ 25-11-29, 1004 ♀ 13-11-29, 1012 ♂ imm. 16-11-29 Nallamallai Range 2,000 ft.; 1111 ♂ 14-12-29, 1160 ♂ 23-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
11 ♂	17-19	51-58	30-35.5	15-17 mm.
5 ♀	16-17.5	52-55.5	30-32.5	14-15.5 mm.

Hume tells us (S.F., v, 270) that the Purple-rumped Sunbird is found throughout the Madras Presidency but I have so far failed to trace any record from the area north of the Godavery Valley and it was not reported by the Survey from the camps in the Vizagapatam Hills. South of the Godavery it is so common—indeed it is the common species of Sunbird in the Presidency—and generally distributed that it is here only necessary to point out certain exceptions. In the Nilgiris it is said by William Davison to occur only up to 2,500 ft. In the Palnis Fairbank's account implies that that it is only found at the lower altitudes. In Travancore Ferguson says that it is never found in the hills.

The breeding season is said to be February and March in Travancore (Ferguson). At Madras it is also mainly in March (Dewar). William Davison however saw young in a nest at Madras late in December (N. & E., 2nd. ed., ii, p. 263) and Theobald (*loc. cit.*, p. 264) considered that at Sooramungalum, Salem August was the laying season.

There are no separable races of this species but the bill averages slightly longer in the Bombay Presidency than in Ceylon. The male of this species does not moult into a non-metallic winter plumage, and the young male assumes the metallic plumage at the postjuvenal moult. This accounts for the apparent increase of the adult males at the end of the hot weather in Coorg as remarked on by Betts (J.B.N.H.S., xxxiii, p. 547).

Arachnothera longirostra longirostra (Latham).

Certhia longirostra Latham, Index Orn., vol. i (1790), p. 299—Bengal.

Not obtained by the Survey. The Little Spider-Hunter is in the Presidency confined to the western side. Never very numerous it is found on the Malabar Coast, throughout the Wynaad, on the slopes of the Nilgiris up to about 5,500 ft., in the Nelliampathies and Palnis (4,000 ft.) and throughout the Travancore Range from about 2,000-5,000 ft.

The only breeding record I have seen for our area is that by Cardew (J.B.N.H.S., x, 149) of two nests between June and September at Ootacamund.

I can find no difference between birds from S.-W. India and the Duars, Assam topotypical range.

Dicaeum concolor concolor Jerdon.

Dicaeum concolor Jerdon, Madras Jour. Lit. Sci., vol. xi (1840), p. 277—Malabar Coast.

The Nilgiri Flowerpecker is confined to the western side of the Presidency and was therefore not met with by the Survey. On the western side it is found throughout the Wynaad, all over the slopes of the Nilgiris and most abundantly on the plateau. It is common at Kodaikanal in the Palnis. In

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Travancore, Ferguson says that it is common from the foot of the hills to the summits and may occasionally be found in the low country. According to the *New Fauna* (vol. iii, p. 430) the breeding season lasts from February to April, but many birds have second broods in May and June. Miss Cockburn however found eggs in January (N. & E., ii, 274).

In the *New Fauna* the race *D. c. subflavum* is said to be distributed in 'Belgaum, North to Khandala and Mahableshwar; east to the Central Provinces'. This race is based on three specimens from Belgaum, one from Savant Vadi and one from Mahableshwar in the British Museum, and appears to me to require confirmation. At any rate in Belgaum, Butler apparently considered it a rains visitor (S.F., ix, 391) and I have seen three specimens from the Nilgiris which could not be separated from the Belgaum specimens. The extension to the Central Provinces in any case cannot be accepted. It is based on a doubtful record from Bilaspur by Blanford which Hume threw doubt on fifty years ago (S.F., vii, p. 208).

Erroneous records are hard to eradicate. It may therefore be pointed out here that the record of *Dicaeum concolor olivaceum* breeding at Gorakhpur in April (J.B.N.H.S., xxii, 539) is incorrect. The specimen is in my collection and really pertains to *D. erythroryhnchos*.

Cinnyris concolor Sykes, P.Z.S. 1832, p. 99, does not refer to this species but is a synonym of *Æthopyga siparaja vigorsii* Sykes.

Dicaeum erythrorhynchos erythrorhynchos (Latham).

Certhia erythrorhynchos Latham, Index Orn., vol. i (1790), p. 299—India (Restricted to Bombay *New Fauna*, vol. iii, p. 432).

Specimens collected:—576 ♂ 21-7-29 Gingee; 1352 ♂ 8-2-30 Anantagiri 3,000 ft.; 1483 juv. 6-3-30, 1489 ♀ 7-3-30, 1509 ♀ 9-3-30 Sankrametta 3,000 ft.; 1745 ♀ 29-4-30 Jeypore Agency 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	11-12.5	49-49.5	23-24	11.5-12.5 mm.
3 ♀	10.5-11.5	46-47.5	22-24	12-12.5 mm.

Tickell's Flowerpecker was found by the Survey to be common in the Vizagapatam Hills at Anantagiri and Sankrametta in February, March and April. This was evidently the breeding season as in addition to the juvenile obtained the females collected in March were either laying or had recently laid. The Gingee specimen provides the only other record for the eastern side of the Presidency.

On the west it is better known. Betts states that it is a common resident in Coorg, breeding about April. It occurs in the Wynaad and round the base of the Nilgiris (Burliar; Goodalor) and Colonel Sparrow has lent me a specimen collected at Malappuram, S. Malabar, on 14 June 1912. Fairbank says that it is common in the plains about the base of the Palnis—a specimen collected by him at Periakulam at the E. base of the Palnis on 5 January 1877 is in the British Museum—and that it was also sometimes observed on the hillsides. In Travancore, according to Ferguson it is found throughout the hills from their base to their summits, occurring also occasionally in the low country. He found a nest with young at Trivandrum on 16 March.

Piprisoma agile agile (Tickell).

Fringilla agilis Tickell, J.A.S.B., vol. ii (November 1833), p. 578—Bhorabhum and Dholbhum.

The Thick-billed Flowerpecker was not procured by the Survey and its distribution in the Presidency is not easy to define. I have only traced the following records. Jerdon says 'I have procured it in Goomsoor and the Eastern Ghats' (B. of I., vol. i, 376). There is a specimen in the collection of the Bombay Natural History Society collected by Mr. J. P. Cook in the Wynaad on 3 January 1894. In the Hume collection there are 4 specimens collected by Miss Cockburn at Kotagherry on 22 September 1874.

The amount of grey or green in the upper plumage of this Flowerpecker

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and the amount of streaking on the lower parts is purely a question of individual variation. There is only the one race throughout the range in the Indian Peninsula. Hume (S.F., i, 434) suggested that the Ceylon bird is separable but I have seen no specimens from that island.

Pitta brachyura (Linnaeus).

Corvus brachyurus Linnaeus, Syst. Nat., ed. xii, vol. i (1766), p. 158—Ceylon.

Specimens collected:—15 ♂ 27 ♀ 11-4-29, 68 ♂ 16-4-29 Kurumbapatti.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	23.5-24.5	106.5-107.5	37-40	36.5-37.5 mm.
1 ♀	23.5	108	39	36.5 mm.

The status of the Indian Pitta is well-known on the western side of the Presidency but on the eastern side we know comparatively little about it. Jerdon tells us that he saw it in Goomsoor (Madras Jour. Lit. Sci., x, p. 251). LaPersonne says that he saw and heard it at Sankrametta at 3,500 ft. in the thick evergreen forests though no specimens were actually collected. Between here and Nellore, where Jerdon says he found it exhausted on passage, there are no records. About Madras it is fairly well-known as a straggler in compounds and topes. Dewar considered it a resident but this seems unlikely and Jerdon who originally thought it a winter visitor says definitely that it occurs chiefly on the spring passage at the beginning of the hot weather when the strong winds blow from the west. Captain Bates however tells us of a bird picked up dead in December and there are three February specimens in the Hume collection.

The Survey found it common in the Kurumbapatti Forests in April and Mr. LaPersonne thought that it was breeding then, though this was not proved. Jerdon mentions it as occurring in winter at Trichinopoly.

On the west the records are definite that it is a winter visitor, fairly common in Coorg (Betts), never very numerous in the Wynaad and Nilgiris (William Davison), common in the Nelliampathies (Kinloch) and in Travancore (Ferguson). The latter says that it occurs in the low country and in the hills up to 2,500 ft. In the Nilgiris it is found as high as Ootacamund. Colonel Sparrow has a female killed at Malappuram on 14 December 1912. As this Pitta is a winter visitor to Ceylon from October to April it must be a passage migrant somewhere in the Presidency and this fact probably explains the records on the eastern side. The western birds doubtless travel up the line of the Western Ghats as there are various passage records for Mount Aboo, Deesa, Bombay, Sholapur, Belgaum etc. Much more information is, however, required before we can work out the breeding distribution and the marked migrations of this most interesting species, whose distribution and status are so obscured by the account in the *New Fauna*.

Picus xanthopygaeus (Gray).[1]

Brachylophus xanthopygaeus Gray, Cat. Birds Nepal (1846), p. 117—Nepal. Nom nov. quoted as synonym of *Geocinus striolatus* (Blyth) 1843 preoccupied.

Specimens collected:—177 ♂ 5-29 Shevaroy Hills; 288 ♀ 29-5-29 Chitteri Range 2,000 ft.; 725 ♂ 21-8-29 Palkonda Hills 1,000 ft.

Measurements:—

	Bill.[2]	Wing.	Tail.[2]	Tarsus.
2 ♂	31-34.5	130	76-87	24-25.5 mm.
♀	34.5	130	86.5	26 mm.

The Little Scaly-bellied Green Woodpecker appears to be nowhere very numerous in the Presidency. For the Eastern side Jerdon's statement that he

[1] Mr. Betts' interesting note on the Woodpeckers of Southern India (*J.B.N.H.S.*, xxxvii, pp. 197-203) unfortunately appeared too late for inclusion in this paper.

[2] A good deal of variation in the size of the bills and tails of Woodpeckers must be discounted as they suffer greatly from wear.

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found it tolerably abundant in the Eastern Ghats is all that there is to supplement the above Survey records. On the west William Davison says that it is sparingly spread through the Wynaad and the Nilgiris. A few pairs are always to be found in the forests about Ootacamund but it is rarer at that elevation than lower down.

In the Palnis Fairbank records it at Periur 4,000 ft. on 15 June while Terry says that he saw it 2 or 3 times at Pulungi and very frequently at Pittur.

Ferguson had only two records for Travancore—one specimen obtained at Cape Comorin in January 1902 and another at Quilon at the beginning of 1903.

The breeding season in the Presidency does not seem to have been recorded.

The reasons for not considering this Woodpecker a race of *Picus vittatus* have been given in detail both by Kloss (Ibis 1926, pp. 684-689) and Ticehurst (J.B.N.H.S., xxxvi, 932), and need not be repeated here. I have independently arrived at the conclusion elaborated by Ticehurst (*loc. cit.*) that Mr. Stuart Baker's North-Western Himalayan race *dehrae* [Bull. B.O.C., xlvi (1926), p. 69—Dehra Dun] is not recognisable.

Picus chlorolophus chlorolophus Vieillot.

Picus chlorolophus Vieillot, Nouv. Dict. d'Hist. Nat., nouv. ed., vol. xxvi (1818), p. 78—Bengal.

Specimen collected:—1701 ♀ 18-4-30 Jeypore Agency 3,000 ft.

Measurements:—

Bill.	Wing.	Tail.	Tarsus.
25.5	125	86	19 mm.

Evidently breeding as an incubation patch was present. This is a most interesting record. Not only does it provide an addition to the Presidency list but it suggests the correctness of certain old records which were discredited in the *Old Fauna*, vol. iii, p. 24 and omitted in the *New Fauna*, vol. iv, p. 17. For Ball says (S.F., vii, p. 206) that the Small Himalayan Yellow-naped Woodpecker occurs in Orissa, south of the Mahanadi, Cuttack (on Jerdon's authority), and probably Lohardugga. The single specimen collected lacks almost entirely the golden sheen on the upper parts which is almost invariably present in Himalayan specimens.

Picus chlorolophus chlorigaster

Picus chlorigaster Jerdon, Madras Jour. Lit. Sci., vol. xiii, pt. 2, 1844 (after August 1845), p. 139—S. India.

Specimen collected:—1025 ♂ 22-11-29 Nallamallai Range 2,500 ft.

Measurements:—

Bill.	Wing.	Tail.	Tarsus.
28	127.5	88.5	20.5 mm.

The South Indian Yellow-naped Woodpecker is best known on the western side of the Presidency. In Coorg according to Betts it is widely spread but nowhere numerous. Specimens from Cannanore (Wardlaw-Ramsay), Calicut (Hume collection) and the Wynaad (Hume collection) are in the British Museum and William Davison says that it is nowhere very common either in the Wynaad or in the Nilgiris where it occurs on the slopes up to 5,000 ft. Major Pythian Adams found a pair breeding as high as 6,000 ft. (Baker and Inglis, B. of S. India, p. 135). A specimen from Malappuram is in Col. Sparrow's collection. In Travancore it is fairly common in the hills at moderate elevations (Ferguson).

On the eastern side Stuart Baker (*New Fauna*, iv, p. 19) says that it is apparently found only from Madras southwards. The above Survey specimen, however, provides the only record which I have been able to trace on the eastern side.

The breeding season on the west is said to be from January to early May.

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Dryobates macei macei (Vieillot).

Picus macei Vieillot, Nouv. Dict. d'Hist. Nat., nouv. ed., vol. xxvi (1818), p. 80—Bengal.

Specimens collected:—1542 ♀ 1543 ♂ 14-3-30, 1559 ♂ 17-3-30 Sankrametta 3,500 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	23.5-25	103.5-105	60-61	17-18 mm.

These specimens provide a considerable extension of the known range of the Fulvous-breasted Pied Woodpecker which hitherto has not been recorded south of Muddapur and Calcutta where it is said by Jerdon to be common.

The West Himalayan race of this Woodpecker *Dryobates macei westermani* Blyth (Ibis 1870, p. 163) should certainly be recognised as already pointed out by Dr. Ticehurst (J.B.N.H.S., xxxiv, p. 468). Not only is it considerably larger as shown by Dr. Ticehurst but the indistinct and broken gorget of black spots is more marked in the typical form than in the north-western bird. A series measured give the following results:—

	Bill.	Wing.	Tail.
5 ♂ Western Himalayas	27-30	114-120	66-71 mm.
8 ♂ Eastern Himalayas	23-27.5	103.5-110	54-62.5 mm.
3 ♂ Calcutta	23-25	101.5-106	58-60.5 mm.

There is a marked difference between the size of the sexes in this Woodpecker, as for instance six females (Western Himalayas) measure: bill 23.5-26; wing 109-113.5; tail 58-70 mm. The sexes must be compared separately.

Dryobates mahrattensis mahrattensis (Latham).

Picus mahrattensis Latham, Suppl. Index Orn. (1801), p. xxxi—India, restricted to Belgaum Stuart Baker, *New Fauna*, vol. iv, p. 46.

Specimens collected:—191 ♀ juv., 192 ♂ 6-5-29 Kurumbapatti; 977 ♂ 979 ♀ 7-11-29, 1019 ♂ 1020 [♀] 19-11-29 Nallamallai Range 2,000 ft.; 1515 ♀ 11-3-30, 1582 ♀ 22-3-30 Sankrametta 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
3 ♂	25-27	97.5-104	58-60	18.5-19 mm.
4 ♀	21-24.5	99-109.5	57-61	17.5 mm.

The Yellow-fronted Pied Woodpecker does not appear to be very plentiful in the Presidency and the above Survey specimens provide all the records for the eastern side.

On the west it occurs sparingly in the Wynaad and also in the drier foothills of the Nilgiris. Jerdon tells us that it is rare on the Malabar Coast but that he found it most plentiful in a patch of thin tree jungle near Wulliar in the gap of Coimbatore. Fairbank says—rather surprisingly I think—that it is not uncommon in the Palnis up to 5,000 ft. In Travancore Ferguson only records 2 specimens from Kuttyani about 10 miles from Travancore.

There is no published record of the breeding season in the presidency but on the label of no. 1582 shot at Sankrametta on 22 March Mr. LaPersonne has recorded that it contained a full-sized egg.

It is with considerable doubt that I have included the two Sankrametta specimens under this form. They have wings respectively of 102.5 and 109.5 and Sankrametta is not so very far from Bhorabhum, the type-locality of Tickell's *aurocristatus* which Ticehurst (J.B.N.H.S., xxxiv, 469) considers to be the correct name for the Northern and Burmese race. No specimens from Borabhum are in existence and from the neighbouring area Maunbhum there are only one pair of adults (♂ wing 102.5, ♀ 100 mm.) in the British Museum. Now *Dryobates mahrattensis* is evidently not a species which is very susceptible to climatic influences. It has developed no peculiar Malabar race and even if birds from the extreme north-west are compared with birds from the south

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the recognition of two races is only just feasible. The difference in colour is not constant, the amount of white is only just appreciable in a series, and there is much overlapping in measurements. The single pair from Maunbhum are not therefore really sufficient to settle the exact identity of *aurocristatus* with the northern and southern form, and it is probable, as a matter of fact, that birds from this area are intermediate. Under the circumstances I have kept the two Sankrametta birds with the typical race.

Dryobates hardwickii hardwickii (Jerdon).

Picus hardwickii Jerdon, Madras Jour. Lit. Sci., vol. xiii (1844), p. 138—South India, Goomsoor.

Specimens collected:—128 ♂ 25-4-29 Kurumbapatti; 347 ♀ 6-6-29, 392 [♂] 12-6-29, 396 ♀ 13-6-29 Chitteri Range 2,000 ft.; 706 ♂ 18-8-29 Palkonda Hills 1,000 ft.; 1010 ♀ 1017 ♂ 19-11-29 Nallamallai Range 2,500 ft.; 1328 ♀ 5-2-30, 1406 ♂ 18-2-30, 1446 ♂ 26-2-30 Anantagiri 3,000 ft.; 1541 ♀ 14-3-30 Sankrametta, 3,500 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
6 ♂	13.5-15	72.5-82	34.5-38	12.5-13.5 mm.
5 ♀	14-14.5	73-80.5	35-37.5	12.5-13.5 mm.

This race of the Indian Pygmy Woodpecker is confined in the Presidency to the eastern side where the above series provides the only evidence as to its distribution in addition to Jerdon's statement that it occurs in Goomsoor. In Salem district Mr. LaPersonne says it was fairly common both in the hills and in the plains. In Vizagapatam district he also states that it was fairly common in the wooded parts at Sankrametta at 3,500 ft. It was evidently then breeding as birds were seen carrying food in April.

In the *New Fauna*, vol. iv, Mr. Stuart Baker considers that all the forms of Pygmy Woodpecker found in the limits of his work should be treated as races of one species. I prefer to divide them into two species namely *Dryobates nanus*, with races *nanus*, *semicoronatus* and *canicapillus*, and *Dryobates hardwickii* with races *brunneiceps*, *hardwickii*, *cinereigula* and *gymnophthalmus*. It appears to me that the plumage characteristics of these two groups are quite distinct *inter se*, that whilst there is complete intergrading between the members of each group separately there is no intergrading between the two groups, and finally it appears that in certain areas outside our limits both forms occur.

The type-locality of *hardwickii* is not the Wynaad as given by Mr. Stuart Baker (*New Fauna*, vol. iv, p. 52) but Goomsoor in Ganjam, the first of the two localities in Jerdon's account of his *Dendrocopus moluccensis* (Madras Jour. Lit. Sci., vol. xi, p. 213) for which later (*loc. cit.*, xiii, p. 138) he proposed the new name of *hardwickii*. Jerdon only mentioned the Wynaad to remark that his specimen from there was not the same as his *moluccensis*, later *hardwickii*, and this point is again referred to in the Birds of India, vol. ii, p. 279 and vol. iii, p. 871 (appendix) where this dark Wynaad specimen is identified as *gymnophthalmos* Blyth, synonym *P. cinereigula* Malherbe. All along this Wynaad bird is definitely contrasted with the true *hardwickii*. This initial mistake has thrown Mr. Stuart Baker out in his account of the distribution of the various races and made him overlook the existence of the very distinct Malabar-Travancore race. The existence of this race was recognised by Hargitt (British Museum Catalogue, vol. xviii, p. 331) but his name *Iyngipicus peninsularis* (Ibis 1882, p. 48) is antedated by *Picus cinereigula* Malherbe (Rev. et Mag. de Zool. Nov. 1849, p. 531). Malherbe says that he first discriminated this form from a specimen in the British Museum and his type is still there. It is a male labelled 'Madras' presented by 'H. H. Baber'. This last is a mistake for H. H. Baker, a clergyman correspondent of Blyth's who lived at Allepy in Travancore in the Madras Presidency.

The genus *Iyngipicus* is certainly not separable from *Dryobates* (see Ticehurst, J.B.N.H.S., xxxiv, p. 469).

Dryobates hardwickii cinereigula (Malherbe).

Picus cinereigula Malherbe, Rev. et Mag. de Zool. Nov. 1849, p. 531—Madras = Alleppey, Travancore.

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The Malabar race of the Indian Pygmy Woodpecker is confined to the western side of the Presidency. Betts says that it is fairly common in Coorg, often being found in the mixed hunting parties. It occurs in the Wynaad and on the lower slopes of the Nilgiris being found up to 3,000 ft. (William Davison) or occasionally 4,500 ft. (Betts). Col. Sparrow's collection contains two males killed at Malappuram. Fairbank met with two at Machur on the road between the Lower Palnis and Kodaikanal. In Travancore Ferguson says that it is found both in the low country and up to 2,000 ft. on the hills.

The statement that *D. h. gymnophthalmus* the Ceylon race occurs in extreme southern Travancore is based on two Anjango specimens in the British Museum. It must be remembered however that these Anjango specimens—of which there are examples of most Travancore species in the British Museum, semi-flat skins all of the same type and with the same data—cannot be accepted as evidence of distribution. Ferguson points out that the Shikaris of Anjango did a regular trade in bird skins and that the skins were brought there from other localities.

Micropternus brachyurus phaioceps Blyth.

Micropternus phaioceps Blyth, J.A.S.B., vol. xiv (1845), p. 195—'India proper extending eastwards to Tipperah and Arracan', restricted type-locality Calcutta.

Specimens collected:—1401 ♂ 17-2-30, 1772-1773 ♂ ♀ 5-5-30 Anantagiri 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	27-30	121.5-123.5	61-62	21.5 mm.
1 ♀	29	118.5	57.5	20.5 mm.

These three specimens of the Rufous Woodpecker furnish the only record of this race within the Presidency. Nos. 1772-1773 were presumably a pair and by the state of the organs as noted on the labels were evidently just about to breed.

There has been of late years a good deal of discussion about the races of the Rufous Woodpecker (see in particular Kloss, Ibis 1918, pp. 107-109; Robinson, Ibis 1919, pp. 179-181; Stuart Baker, Ibis 1919, pp. 197-204). There is, we think, no particular difficulty in understanding the position with regard to the Indian Peninsula so long as one appreciates the fact that in India the differences of colour (dull to bright chestnut or bay), the amount of barring on the upper parts (virtually absent to fairly general) and the colour of the head (chestnut to dark brown) are mainly due to individual variation, whilst the character and colour of the squamation on the throat although a good racial characteristic in series is also individually reliable—as in the case of the throat markings in *Brachypternus benghalensis*. Size is of importance but the races grade into each other in this respect.

On the evidence at present available the distribution of the Rufous Woodpecker in India falls into two separate areas with a wide gap between them. In the southern area it is found all down the west coast from Khandala to Travancore and Ceylon extending also to the Shevaroys. In the northern area it is found along the Himalayas from Dehra Dun to Assam and from Bengal southwards to the Balaghat, Chanda and Anantagiri.

In the southern area the squamation of the throat is dark chocolate and white throughout. There is, however, a regular increase in size from Ceylon to the Bombay Presidency. It has been customary of late years to divide these southern birds into two forms *M. b. jerdonii=gularis* and *M. b. lanka*. Kloss (Ibis 1918, p. 108) who named the latter form confined it to Ceylon. Stuart Baker (Ibis 1919, p. 204; *New Fauna*, vol. iv, p. 66) added South Travancore to Ceylon. The difference is only one of size.

It is very difficult to say on the specimens available whether it is worth while recognising two forms in this area, as the increase in size is doubtless gradual with no natural boundary anywhere to mark it.

15 specimens from Ceylon measure: 9 ♂ Bill 26-30, wing 115-122 mm.; 6 ♀ bill 25-28, wing 116-122 mm. Nine specimens from S. Konkan and N. Kanara measure:—4 ♂ bill 28-31, wing 127-130 mm.; 5 ♀ bill 28.5-31, wing 126-129 mm. These wing lengths do not overlap and such specimens as

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I have seen from Travancore, the Nilgiris, Burliar, Calicut, Cannanore and the Shevaroys must clearly go with the smaller Ceylon birds. Seven birds from the Wynaad, on the other hand, are with one exception (♀ wing 123.5 mm.) large birds:—4 ♂ bill 28.5-30.5, wing 126-129 mm.; 2 ♀ bill 28-28.5, wing 126.5-128 mm. Anyone who desires to recognise two races here—and I at present see no value in it—will have to find a new name for the larger birds, as *jerdonii* and *lanka* clearly refer to the same (smaller) bird.

Phaiopicus jerdonii Malherbe, Rev. Mag. Zool. 1849 (November-December), p. 535—Indian Peninsula was described from specimens in the British Museum. Apparently he examined the specimens in London in 1845 and then gave them the manuscript name of *Picus phaiopicus*. At that date there were four specimens in the British Museum, namely two skins (♂ ♀) from 'Madras' presented by the Rev. H. H. Baber and two from 'Madras' from Sir Walter Elliot. Now only the pair of Baber birds in the Museum can be traced and none of Elliot's, though according to the catalogue there should be three of Baber's and one of Elliot's. As Malherbe described a male and female and Baber's are such it seems reasonable to accept them as the types. The Revd. H. H. Baber, the name of the donor, is of course merely a clerical error for the Rev. H. H. Baker, a correspondent of Blyth's who lived at Alipi (Allepey) in Travancore where no doubt the birds were collected. I therefore restrict the type-locality of Indian Peninsula to Travancore. Elliot's 'Madras' birds no doubt also came from somewhere on the lower western coast in or near Travancore.

For the northern area in India the *New Fauna* accepts three races. This is, however, evidently due to the error in the type-locality of *phaioceps* which is given as Arrakan. Blyth said his birds came from 'India proper, extending eastwards to Tipperah and Arracan'. From his catalogue we know that his only specimens when the description was published were a male and female from Calcutta and a female from Tipperah. This had already been pointed out by Robinson (Ibis 1919, p. 180) who states that the types have wings of 115 and 121 mm. I have seen no Calcutta specimens but birds from Sikkim, Duars, Assam, Bihar, Dacca, Tipperah, and Anantagiri and Chanda can certainly not be separated from Burmese and Tenasserim birds. Dr. Ticehurst gives me the following wing measurements of males:—15 ♂ Burma 125-132, 36 ♂ Tenasserim 114, 120-133, 21 ♂ Assam 119-130 mm. and such birds as I have seen from the other localities fall within those measurements. The squamation of the throat, chestnut and buff, however separates these birds from those of the extreme south of India and Ceylon. *M. b. mesos* Kloss, doubtfully accepted by Mr. Stuart Baker is therefore a synonym of *M. b. phaioceps*.

The large bird from the North-Western foothills of the Himalayas (7 ♂ bill 31.5-33, wing 129-144.5 mm.) is, however, a very good race, distinguished not only by its larger size, but by its paler upper parts and paler, rather grayer head. This race is called in the *New Fauna* by Kloss's name. *M. b. humei* (the type-locality is the Kumaon Bhabar not Rohilkand as given), I think correctly, and Robinson appears to have been wrong in considering (Ibis 1919, p. 180) that the correct name should be *M. b. blythii* Malherbe, Rev. Mag. Zool. (November-December), 1849, p. 534—Himalayas. This last is evidently a synonymy for *M. b. phaioceps*.

Phaiopicus blythi Malherbe was in reality a new name for *Phaiopicus rufinotus* (misquoted as *rufanotus*), a manuscript name written on the labels of certain specimens in the British Museum in 1845 (first described by Bonaparte in Consp. Gen. Av., i, p. 113, 1850).

In describing his *Phaiopicus blythi* in 1849 Malherbe (Rev. et Mag. Zool., p. 534) quoted as synonymous *Picus rufanotus* (Malherbe, antea 1845, British Museum), *Meiglyptes badius* (Hodgson, Cat. Nepal Birds) and *Micropternus phaioceps* (Blyth, J.A.S.B., xiv, p. 195). The type-locality is evidently Nepal and not Eastern Himalayas as given in the *New Fauna* since in 1849 there appear only to have been Hodgson's specimens for Malherbe to see in the British Museum. In 1843, 2 males and 2 females were received from Nepal (Hodgson) and early in 1845 one male, one female, and one juvenile were received from the same source and apparently no further examples till some years later. Malherbe described male, female and juvenile. The four males from Nepal now in the British Museum although pale in colour appear to be bleached. Their wings measure 126.5-130 mm.

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Micropternus brachyurus jerdonii (Malherbe).

Phaiopicus jerdonii Malherbe, Rev. Mag. Zool. 1849 (November-December), p. 535—Indian Peninsula, restricted to Travancore.

Specimens collected:—282 ♂ imm. 25-5-29, 265 ♀ 22-5-29, 280 ♀ 24-5-29 Shevaroy Hills 4,000-4,500 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
♂ imm.	23.5	123	63	23 mm.
2 ♀	29	122.5	61	—mm.

On the eastern side of the Presidency, the Rufous Woodpecker is only known to occur on the Shevaroy Hills about 3,000-4,500 ft. where according to Mr. LaPersonne the species is well-distributed, and invariably found wherever there were old silver oak and rubber trees.

On the west it is fairly common in Coorg (Betts). It occurs, though nowhere numerous, in the Wynaad and on the slopes of the Nilgiris and William Davison remarks that he obtained one specimen a few miles from Ootacamund though this was exceptional. Specimens from Cannanore and Calicut are in the British Museum. This Woodpecker does not seem to have been recorded from the Nelliampathies or the Palnis. In Travancore, according to Ferguson it is only seen in the low country and at the foot of the hills.

Brachypternus benghalensis puncticollis (Malherbe).

Specimens collected:—129 ♀ 25-4-29, 154 ♂ juv. 29-4-29 Kurumbapatti; 281 ♂ 24-5-29 Shevaroy Hills 4,000 ft.; 338 ♂ juv. 5-6-29, 339 ♂ juv. 340 ♀ 349 ♂ 6-6-29 Chitteri Range 2,000 ft.; 863 ♀ 2-10-29 Seschachalam Hills 2,000 ft.; 1029 ♂ 24-11-29 Nallamalai Range 2,500 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
3 ♂	34.5-41	140-146	82.5-87.5	25-26.5 mm.
3 ♀	37	137-145.5	86.5-92	24.5-26 mm.

Although the Golden-backed Woodpecker is recorded from Jeypore (Ball, S.F., vii, 206) I have seen no specimen from north of Rajamundry whence a skin in the British Museum collected by Blanford on 1st June 1871 is attributable to this race. Southwards on the eastern side of the Presidency a young male obtained by Wardlaw Ramsay in 1876 at Madras and now in the British Museum supplies the only record other than those furnished by the Survey. In Salem district LaPersonne remarks that it was common over the whole area from the foot of the Shevaroys to the Chitteri Range and Tirthamalai. Westwards it is found to the base of the Nilgiris whence came Malherbe's type. The type-locality of Ceylon given in the *New Fauna* (vol. vii, p. 314) is wrong.

Along the Malabar side it is replaced by the next form.

The races of the Golden-backed Woodpecker are somewhat difficult to make out as there is a good deal of individual variation, which leads to occasional specimens within the area of one form tending to vary in the direction of the characteristics of another form. The red fringing to the feathers found in a greater or less degree on the golden upper parts of many specimens in India has no racial significance beyond the fact that it apparently never occurs in the desert race *dilutus*.

We recognise the followning races, but it is not yet possible to give their full distribution accurately:—

Brachyternus benghalensis benghalensis (Linnaeus).

Picus benghalensis Linn., Syst. Nat., ed. x, vol. i (1758), p. 113—Bengal.[1] Upper parts rich golden-yellow; rump black; shoulder black with conspicuous

[1] Based on Albin, vol. iii, pl. 21, where the specimen is said to have been brought from Bengal in 1737 and to be in the possession of Mr. Dandridge.

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creamy white spotting; chin, throat and breast black, streaked with white; white of lower parts pure.

Assam, Bengal, Bihar, United Provinces, Upper Punjab, Central India, Central Provinces and Orissa.

Brachypternus benghalensis dilutus Blyth.

Brachypternus dilutus Blyth, Cat. Birds. Mus. Asiat. Soc. (1852), p. 56—Scinde.

Upper parts a pale golden-yellow with, in a series, an impression of fine white spotting and dark flecking; rump black; shoulder black with conspicuous white spotting; chin, throat and breast white, streaked with black; white of lower parts pure.

Sindh, Mt. Aboo; birds from the lower Punjab are intermediate between this and *benghalensis*.

Brachypternus benghalensis puncticollis Malherbe.

Picus (*Brachypternus*) *puncticollis* Malherbe, Rev. Zool. 1845, p. 405—India, restricted to slopes of Nilgiris.

Upper parts golden-yellow, intermediate between the above two forms; rump black; shoulder partly black with conspicuous creamy-white spotting; chin, throat and breast black, with small white triangular spots; white of lower parts pale creamy white.

South India, excluding the range of the next form, up to the River Godavery. Birds from Eastern Hyderabad are intermediate between this and *benghalensis*.

Brachypternus benghalensis tehminae Subsp. nov.

Upper parts rich golden-olive yellow; black of rump much restricted and obscured by an olive wash; black of shoulder practically obscured by a golden-olive wash, the spots small or obsolete and yellowish cream in colour; chin, throat and breast black with fine white spotting and barring; white of lower parts with a creamy buff tinge.

West Coast from Malabar to Travancore. Type ♂ no. 475 Travancore Survey Coll. 20 March 1933 Rajampara 1,350 ft., Panthalam Hills. Collected by Mr. Salim A. Ali. (Presented to the British Museum).

Brachypternus benghalensis intermedius Legge.

Brachypternus intermedius Legge, Stray Feathers, vol. iv (December 1876), p. 242—Ceylon.

Very similar to *B. b. puncticollis* but more washed with olive on the mantle; the pale spots on the wing coverts are much smaller and it is altogether a smaller bird with a lighter bill.

Ceylon.

Note.—*Picus ceylonus* Cuvier, Règne Anim., vol. i (1829), p. 451, is erroneously used for this race in the *New Fauna*. It is based on a description, apparently by Forster, in Der Naturforscher, vol. xiii (1779), pp. 14-15, plate iv, which evidently refers to the red bird already described by Vieillot as *Picus erithronotus*. The bird described was a female and is said to have come from Legationsrath Meuschen.

Brachypternus erithronotus (Vieillot) should be treated as a separate species.

Brachypternus benghalensis tehminae Subsp. nov.

This race of the Golden-backed Woodpecker is confined to the plains and lower slopes of the hills. In Travancore it is common in the plains as for instance about Trivandrum. Fairbank found it common in the heavy forest of the Lower Palnis. Kinloch recorded it as very common in the Nelliampathies. William Davison says that it is not uncommon about the base of the Nilgiris and in the better wooded parts of the Wynaad. There are 5 specimens from Calicut (Haines) in the British Museum.

There appear to be no published records of the breeding season in this area.

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Dinopium javanense malabaricum Nom. Nov.

This form of the Common Golden-backed Three-toed Woodpecker is confined to the west of the Presidency and so was not met with by the Survey. Here it is most common in the hills of Travancore where it is said by Ferguson to be one of the most common of all birds though not met with in the low country. It has not been recorded from either the Palnis or Nelliampathies and in the Nilgiris it is certainly less common, occurring up to 5,000 ft. William Davison considered it uncommon in the Wynaad but in Coorg Mr. Betts tells me that it is very common round Mercara in woodland country, often joining the mixed hunting parties.

Further north beyond our limits it extends as far as North Kanara.

I find no evidence for the statement that this race occurs in Orissa (*New Fauna*, vol. iv, p. 74). The only record of any form of Golden-backed Three-toed Woodpecker in this area is in Blyth's catalogue no. 253 where a specimen of *Tiga* (*Dinopium*) *shorei* is listed from Gumsoor in Ganjam.

This raises the point whether the name *Picus rubropygialis* Malherbe, Rev. Zool. (November-December), 1845, p. 400, can possibly refer to this race. Malherbe himself said that he had only seen a single specimen and that a mounted female which came from Bengal. Jerdon's statement (B. of I., i, p. 299) that the type came from Bangalore is of course merely a *lapsus calami*. There is in the British Museum a specimen that is probably the type. It is a dismounted female, said to be from India and presented by Mr. J. Inskipp. It was in the collection prior to 1837 and was still the only specimen of its kind at the date of Gray's Catalogue of 1868. This specimen is certainly neither the South Indian nor the Himalayan form but evidently agrees with the typical race. If it is the type—and the presumption is strong—India must mean the East Indies and refer to the far east, as is so often the case in these early descriptions, and *rubropygialis* Malherbe is a synonym of *javanense*. In any case the South-West Indian form is left without a name so for it I propose

Dinopium javanense malabaricum

Type ♂ 23-4-1881 Manantoddy, Wynaad. Collected by William Davison. In the British Museum, Register No. 1887.8.10.2019.

It differs from the typical race in being duller and darker with a more olive wash in the golden colour of the upper parts. In size it is larger, wing ♂ 135-142, ♀ 137.5-139 mm. The olive wash also separates it from the Burmese bird *D. j. intermedium* compared with which it is somewhat smaller.

Chrysocolaptes festivus Boddaert.

Picus festivus Boddaert, Table Pl. Enlum. (December 1783), p. 43 for Pl. Enlum, 696—Goa, India.

Not met by the Survey. As in most parts of India, the Black-backed Woodpecker is rare in the Presidency. I do not know where Jerdon was referring to when he said (B. of I., vol. i, p. 283) that he had found it in the jungles of the Eastern Ghats. Hume said (S.F., x, 355) that he had received it from the northern bases of the Nilgiris and there are two Nilgiri specimens in the British Museum, namely a male with no precise locality dated 8 June 1875 (Watkins) and another male dated September 1876 from the Coonoor Ghat (Wardlaw-Ramsay). The *New Fauna* states that the Revd. Howard Campbell took an egg in the Nilgiris on 28 January.

The statement, also in the *New Fauna*, that Stewart took an egg in Travancore on the 4th February provides the only record that I have traced for that State.

It was unnecessary (*New Fauna*, iv, 77) to cite the analogy of *C. strictus* in order to suggest that the young have the crown black, spotted with white. Bell (S.F., ii, p. 391) and John Davidson (S.F., x, 279) had already recorded that the crown and crest of the young are yellow tipped with red or flame-coloured, presumably a sexual difference, and this is corroborated by a newly fledged bird from Raipur in the Hume collection.

I have not seen proper material from Ceylon to settle the question whether Ceylon birds are separable. They are said by Legge to be smaller with weaker beaks.

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Chrysocolaptes guttacristatus guttacristatus (Tickell).

Picus guttacristatus Tickell, J.A.S.B., vol. ii (after December 1833), p. 578—Borabhum.

Specimen collected:—1479 ♀ 5-3-30 Sankrametta 3,500 ft.

Measurements:—

Bill.	Wing.	Tail.	Tarsus.
50.5	109	91	32 mm.

Tickell's Golden-backed Woodpecker was not common in the Vizagapatam district. A few pairs were seen.

This is the only record for the Presidency and it is evident that we are here on the southern limit of the typical form.

Chrysocolaptes guttacristatus chersonesus Kloss.

Chrysocolaptes strictus chersonesus Kloss, Ibis 1918, p. 113—(Singapore Island).

This race of Tickell's Golden-backed Woodpecker is distributed along the West Coast of India and so was not met by the Survey. It is common in the Presidency and like all others of our Woodpeckers is strictly resident.

In Coorg it is much the commonest and most conspicuous Woodpecker as Mr. Betts tells me that his record to that effect under *Brachypternus benghalensis* (J.B.N.H.S., xxxiii, p. 548) should really refer to this species. In the Wynaad, William Davison considered it not uncommon. It is common on the slopes of the Nilgiris and occurs in smaller numbers on the plateau. In the Nelliampathies and the Palnis, it is common, occurring in the latter hills from top to bottom. Kinloch gives us a note about its roosting habit (J.B.N.H.S., xxiii, p. 546). In Travancore it seems to be less common. Bourdillon (S.F., iv, 389) says that it inhabits the lower ranges of forest. Ferguson, however, says that he has shot it at 3,000 ft. and also 6,000 ft. on the High Range, usually in the neighbourhood of streams. A female collected by Mr. Prater at Madura is in the Society's collection.

In Coorg, Betts says that the young hatch about the first week of March. In the Nilgiris according to William Davison and Darling, December, January and February are the breeding season (N. & E., ii, 313) and Howard Campbell took eggs in March near Ootacamund (*New Fauna*, vol. iv, p. 81).

It is quite certain that the name *Indopicus delesserti* Malherbe, Mem. Acad. Metz., vol. xxx (1849), p. 343, commonly used for the South Indian race cannot properly refer to it. The type-locality is not Malabar as given in the *New Fauna*, vol. vii, p. 317, but simply 'L'Inde' and it is evident from a perusal of Malherbe's descriptions that he was not referring to the South Indian form at all. He says that he had only seen two specimens, both females, of which the actual locality was not precisely known. These two birds are contrasted in the description with *sultaneus* and *strictus*. This latter name Malherbe applied to the South Indian bird of which he said he had received several examples from Jerdon who stated that they were found commonly in Malabar and South-East India.

M. Berlioz informs us that a pair of Woodpeckers, not 2 females, in the Paris Museum are believed to be the types of Malherbe's *delesserti*. Both measure approximately the same, viz.:—bill from frontal feathers 43 mm., wing 172-173 mm. This is too big for the South Indian form (wing ♂ 149-159, ♀ 147-158 mm.) and agrees roughly with a measurement of 170-180 mm. for the folded wing as given in Malherbe's description. Hume has already suggested (S.F., viii, 154) that Malherbe's birds were probably from the somewhat intermediate zone of Burma, and the name *Indopicus delesserti* Malherbe must be considered as a synonym of the typical form.

What name should take its place? Mr. Stuart Baker says (*New Fauna*, vol. iv, p. 81) that he cannot separate South Indian birds from others from Peninsular Burma and Siam and Malaya which have been named *indomalayicus* (type-locality Junk-Seylan) by Hesse and *chersonesus* (type-locality Singapore Island) by Kloss. Kloss has shown that the former name is a synonym of the typical form (Ibis 1918, p. 112). The latter race appears to be based entirely

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on size and I can see no colour difference. No proper series has been available for examination but Robinson and Kloss give the range of measurement for both sexes as 142-150 mm. [J.N.H.S. Siam, vol. v, No. 2 (October 1923), p. 196]. Ten birds (5 ♂ 5 ♀) measured from S.-W. India have wings 147-159 mm. This slight discrepancy seems hardly worth recognition and would doubtless disappear if a larger series from both localities were compared. I have no doubt that in this species we have another example of the fact that birds at the extremities of the horse-shoe Ceylon, India, Burma and Malaya are alike and therefore propose to use the name *chersonesus* for the S.-W. Indian bird.

Hemicircus canente cordatus Jerdon.

Hemicircus cordatus Jerdon, Madras Jour. Lit. Sci., vol. xi (1840), p. 211—Malabar.

Not obtained by the Survey. The Heart-spotted Woodpecker is confined to the western side of the Presidency where it is fairly well-known. In Coorg it is certainly rare but Mr. Betts tells me he has met with it on two occasions. It is sparingly distributed throughout the Wynaad and more commonly on the western slopes of the Nilgiris up to 3,000 ft. (William Davison) or 4,500 ft. (Betts). There are 3 birds from Calicut in the Hume collection. Further south it is commoner, both in the Nelliampathies (Kinloch) and in Travancore where it is found both in the low country and on the hills.

The only breeding records in our area are from Travancore. Mr. C. Primrose took single eggs on November 26th and December 15th (J.B.N.H.S., xxxv, 207) and Bourdillon (S.F., iv, 389) found it excavating in February. Mr. Stewart found it breeding from January to March (*New Fauna*, iv, 85).

The range on the west is rather more extensive than the *New Fauna* makes clear. Not only did Laird obtain it in N. Kanara, as stated, but so did Bell and John Davidson found that it occurred both above and below ghats in that district and Aitken took eggs near Castle Rock on 10 January (J.B.N.H.S., xi, 679). Laird also obtained it in the Forests west of Belgaum (S.F., ix, 385) and Butler (S.F., v, 503) shot the female of a pair at Khandala.

Both sexes bear tufts of bristly feathers in the middle of the back, which are usually covered with a gummy substance, which has a very strong peculiar, somewhat resinous but decidedly pleasant smell. Both the viscidity and the scent completely disappear after the specimen has been preserved a short time (William Davison, S.F., vi, 127). Nothing is known of the purpose of this unusual feather, and whether it is seasonal or not. The point may be commended to observers for investigation.

Macropicus javensis hodgsoni

Hemilophus hodgsonii Jerdon, Madras Jour. Lit. Sci., vol. xi (1840), p. 215, pl. ii—Malabar.

The Malabar Great Black Woodpecker is confined in the Presidency to the western side where it is somewhat local in distribution and dependent on the condition of the forest areas. Jerdon tells us that he saw it in Coorg and at the foot of the Peria Pass. It is not uncommon in the Wynaad according to William Davison. In the Lower Nilgiris it is apparently very scarce and local according to Mr. Betts and Davison once obtained it in Bamboo-jungle near Goodalore. In the Nelliampathies it is common and there Kinloch wrote a series of notes on its habits and breeding (J.B.N.H.S., xxvii, p. 941; xxix, pp. 294 and 561). In Travancore Ferguson says that it is confined to the forests between 500 ft. and 3,000 ft. elevation.

According to Kinloch the eggs are laid about the end of January in the Nelliampathies.

For the mistakes in the *New Fauna* over the specific name of this bird, see Ticehurst, J.B.N.H.S., xxxvi, 933. The specimen described by Jerdon was sent to him by Mr. Vaughan the Circuit Judge at Tellicherry.

Vivia innominatus malayorum (Hartert).

Picumnus innominatus malayorum Hartert, Vog. Pal. Fauna, vol. iii (1912), p. 937—Perak.

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Specimens collected:—1445 ♂ 26-2-30 Anantagiri 3,000 ft.; 1476-1477 ♀♂ 5-3-30; 1632 ♀ 31-3-30 Sankrametta 3,000-3,500 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	11.5-12	57.5-59.5	30-32	12 mm.
2 ♀	11-11.5	58-59.5	30-31	12-13 mm.

Mr. LaPersonne says that these Speckled Piculets were not uncommon at Anantagiri and Sankrametta and it was evident from the organs that they were breeding in March. The courtship consisted in the male pursuing the female round and round the branch of a tree in little jerky movements, always working downwards.

The discovery of this species in the Vizagapatam area was one of the surprises of the Survey as the species was within India hitherto only known from the Himalayas from Hazara to Upper Assam and in South-West India from N. Kanara to Travancore. The series obtained by the Survey cannot be separated from Burmese-Malayan birds.

Vivia innominatus avunculorum (Hartert).

Picumnus innominatus avunculorum Hartert, Vog. Pal. Fauna, vol. ii (1912), p. 937—Kotagherry, Nilgiris.

In South-West India the Speckled Piculet seems to be very rare. The *New Fauna* (vol. iv, p. 94) gives the range as the Nilgiri and Wynaad Hills, Agrore and Travancore Hills. Leaving aside the fact that Agrore is in Hazara, N.-W. Himalayas, this distribution overlooks the fact that the bird has been recorded as far north as N. Kanara (John Davidson, J.B.N.H.S., xi, 679).

In the Presidency the bird was first recorded from the Wynaad where it was obtained by Mr. Darling on the 8th July 1877 (Hume, S.F., v, p. 351). This specimen is in the British Museum and a second obtained in the Wynaad by Mr. J. P. Cook on 1st January 1894 is in the Society's collection. The type of *avunculorum*, a male obtained on 14 March 1881 at Kotagherry is in the British Museum. Mr. Betts informs me that he has once or twice seen a pair in the Ochterloney Valley and that they were active and restless in behaviour. In Travancore, Ferguson states (J.B.N.H.S., xii, p. 203, and xv, p. 656) that he shot one and saw another at 4,000 ft. in heavy jungle at Chimunji. Stewart has also obtained it in Travancore according to the *New Fauna*.

I have only been able to examine 4 specimens of this race and on them should have had considerable hesitation in separating this race from *V. i. malayorum*, which takes page precedence. Dr. Hartert however in his description is so emphatic that this race is recognisable at the first glance and indeed almost merits recognition as a full species, that I deem it better to be guided by his decision until further material is available.

Jynx torquilla Linnaeus.

Jynx torquilla Linnaeus, Syst. Nat., ed. x (1758), p. 112—Europe; restricted type-locality Sweden.

The *New Fauna* (vol. iv, p. 99) states that the typical race of the Wryneck occurs in the greater part of India but particularly on the western side and in Southern India and (p. 100) that *Jynx torquilla japonica* occurs in the greater part of Eastern India as far south as Madras. The evidence for these statements is—so far as our Presidency is concerned—unknown to me. Jerdon states that he obtained the Wryneck at Nellore and Madras (B. of I., vol. i, p. 304) and Dewar, probably on this evidence, says that it is 'Not at all common at Madras' (J.B.N.H.S., xvi, p. 491). There is one old specimen from 'Madras' in the Gould collection in the British Museum. The species was not obtained by the Survey and I have no other information regarding it.

(To be continued).

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THE GAME BIRDS AND ANIMALS OF THE MANIPUR STATE WITH NOTES OF THEIR NUMBERS, MIGRATION AND HABITS.

BY

J. C. HIGGINS, I.C.S.

PART VI.

(*Continued from page 95 of this volume*).

QUAILS.

Five species of quail reside and breed and two migratory species have been recorded, but are most uncommon. There are not sufficient quail anywhere to make it worth while to go out after them alone. A few are bagged out snipe or partridge shooting, but many sportsmen let most of them go as not being worth powder and shot. The best bag is 110, in 1915-16. The Manipuri name for all the quails is *sorbol*, irrespective of species. The name is sometimes corrupted to *soibol*.

The Japanese Grey Quail (*Coturnix coturnix japonica*).

One specimen is recorded as having been shot in Manipur in 1899.

The Common or Grey Quail (*Coturnix coturnix coturnix*)—Manipuri, *sorbol*.

This species is rare in Manipur, as it is in Assam: as Baker[1] says, it only 'struggles into that province'. Further, the variation in the numbers seen from year to year is considerable. In some years a fair number are bagged, while in others not a single one is flushed. The same seems to be true of the Assam valley. In 1920-21, the first year I was in Nowgong, I bagged 15: in 1921-22 and 1922-23 I never saw one. The earliest recorded in Manipur was shot on September 3rd (1919) and the latest on April 20th (1919), but these are the only records in September and April. Only 80 have been shot since 1910, the best year being 1916-17, when 17 were bagged. The best days were:—

10-3-17	... 5
19-1-26	... 4

Being always on the lookout for *C. c. japonica*, and not being entirely certain of my identification, I submitted a single skin to

[1] Op. cit., *J.B.N.H.S.*, vol. xxix, No. 3, p. 583.

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the Society in 1916, followed by a small series in the next year. With reference to the single skin, Mr. Millard wrote:—

> 'It is a very difficult matter to say exactly which species this is. It does not tally exactly with either the description of *japonica* or *communis*. So far as we can ascertain, the specimen sent is mid-way between these two species, having points of resemblance to both. . . . It is probable they interbreed and on the border line where the two species meet one would find birds grading into either *japonica* or *communis*.'

and later:—

> 'In Japan and China *coturnix communis* during the breeding season occupies the same tract of territory as *c. japonica* and there is no doubt that all sorts of hybrids are produced.'

With regard to the series he wrote:—

> 'The quail are all *Coturnix communis japonica*, as they undoubtedly would be, situated as you are on the border line of these two species.'

I have always examined my Grey Quail carefully, and most of the specimens I have shot appear to be intermediate between the two races, though some approximate very closely to *C. c. coturnix*. The throat feathers are only slightly, not definitely lanceolate: but the reddish tint of the throat and flanks is very noticeable, in comparison with the typical Grey Quail. But I have never found a specimen which was sufficiently close to the description of *C. c. japonica* to make it worth while sending the skin for identification, on suspicion of its belonging to that species. The true *japonica* must be very rare indeed in Manipur.

Baker[1] refers to 'breeding birds being found as far east as Manipur'. He does not quote his authority for this statement, and I have no confirmation of its breeding, unless the bird shot in April can be taken as such: but this does not seem to be very conclusive evidence.

The Indian Blue-breasted Quail (*Excalfactoria chinensis chinensis*)—Manipuri, *sorbol*.

As Baker[2] remarks, 'this species is very common in Manipur'. At the same time, it is only found in small parties, and I have only once seen them sufficiently thick to allow of anything like a 'bag' being made—on March 22nd, 1916, when we shot 13 and could have shot more. The next best bags were 8, on January 10th, 1916, and January 19th, 1919. The best year's bag is 68, in 1915-16. In the hills I have never found them plentiful, even where the terrain is suitable. They like wetter country than most of the quails and are frequently put up on grazing grounds at the end of the rains, when snipe shooting, and occasionally in bogs, especially in the spring. As a table bird they are far superior to the Grey Quail.

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[1] Op. cit., *J.B.N.H.S.*, vol. xxix, No. 3, p. 580, and *Fauna of British India*, vol. v, p. 373.

[2] Op. cit., *J.B.N.H.S.*, vol. xxix, No. 1, p. 4.

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The Manipur Bush Quail (*Cryptoplectron manipurensis manipurensis*)—Manipuri, *sorbol amubā* ('the black quail'): I have never heard it called *lāng sorbol* ('the snare-quail').[1]

This sporting little bird appears to be getting scarcer, as the last 13 years have only produced 93 birds—the same number as the four seasons 1915-16 to 1918-19. The decrease is probably due to increasing population and the consequent spread of cultivation. None have been shot in the past two years, and I have not even seen one. The best year is 1918-19, when 42 were shot. Good days were:—

24-3-26	... 17
10-3-17	... 14
19-3-29	... 13

Hume's[2] failure to flush them by burning the grass is not surprising. Partridges very rarely fly out of burnt grass and quails never, probably from fear of the hawks which hover round, eating the insects. The birds break out at the edges and run to the nearest cover. Inglis[3] has remarked this characteristic, in his notes on *C. m. inglisi*.

There is nothing to add, regarding their habits, to the notes recorded in the Journal by Baker and Inglis (referred to above), and by Connor.[4] I have seen these birds in the bogs and swamps in the south of the valley and also in the glens which run into it.

The Burmese Bustard-quail (*Turnix suscitator plumbipes*)—Manipuri, *sorbol*.

Fairly common, both in the valley and in the hills, in suitable localities, but nowhere really plentiful. The best year's bag is 18, in 1917-18, and good days were:—

22-3-25	... 9
5-3-18	... 7

This bird, like the other button-quails, is better eating than the Grey Quail.

The Little Button-quail (*Turnix dussumieri*)—Manipuri, *sorbol*.

This bird is not common, but occurs in suitable localities, as Baker[5] says, 'mostly in fairly wide stretches of *sun*-grass, not necessarily very long or very dense'. I have also shot it on grazing grounds with very little cover. The best year's bag was 7 in 1925-26. Only 18 have been bagged altogether, but, like the other small quail, they are sometimes allowed to go unmolested.

The Burmese Button-quail (*Turnix maculatus maculatus*)—Manipuri, *sorbol*.

This species is very scarce. It has been recorded on 13 occasions only, but personally I have only seen it five times in 17

[1] *Fauna of British India*, vol. v, p. 383.
[2] Baker, 'Game Birds of India, Burma and Ceylon', *J.B.N.H.S.*, vol. xxix, No. 4, p. 858.
[3] *J.B.N.H.S.*, vol. xix, No. 1, p. 3.
[4] *J.B.N.H.S.*, vol. xviii, No. 2, p. 496.
[5] *Game Birds of India, Burma and Ceylon*, vol. iii, p. 34.

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seasons, and cannot vouch for the identification of the other eight being correct. Indeed, it is almost certainly not so: many sportsmen call the Blue-breasted Quail a 'button-quail', on account of its small size, and as that species has yellow legs, it is, I know, sometimes classified as this bird in error. Of my five birds, four were obtained in the Manipur valley and one in the Jiri valley, on the Cachar border. I have never seen it in the hills. The identification of the Manipur bird as *T. m. maculatus* and not *T. m. tanki* was confirmed by the Society, and it was remarked that the specimen sent 'differed slightly from the Burmese specimens, being darker'.

Pigeons and Doves.

Doves of various species are common in the Manipur valley: pigeons are fairly common in the hills, but very rare in the valley. Consequently, the Manipuri has different names for the doves, but does not distinguish between the various species of pigeon and lumps them all together under the term *lam khunu* ('wild pigeon') or *ching khunu* ('hill pigeon'). Only 83 pigeons have been shot since 1916, many of them in the Kabaw valley of Burma, where they are plentiful.

The Bengal Green Pigeon (*Crocopus phœnicopterus phœnicopterus*).

Baker[1] says that south of the Naga Hills (which lie immediately north of Manipur) this species and the Burmese race (*C. p. viridifrons*) overlap. In the plains of the Surma valley, immediately to the west, which he knew well, he ascribes the birds to an intermediate type, tending towards *viridifrons*. I have never seen any of either species in Manipur itself, though I have no doubt they occur. But I have shot them on several occasions in the Kabaw valley, just across the Burma border, where they are plentiful, and all the specimens I have examined appeared to fall under the description of *phœnicopterus*. This identification was confirmed by the Society in the case of a specimen sent up in 1916. It may be noted that, while Wickham[2] speaks of *viridifrons* as common in the Upper Burma hills, Hopwood and Mackenzie[3] classify the bird of the northern Chin Hills, which adjoin both Manipur and the Kabaw valley, as *phœnicopterus*.

The Ashy-headed Green Pigeon (*Dendrophasa pompadora phayrei*).

This species is fairly common in the hills. I shot a single bird in a village on the west edge of the Manipur valley, about 2 miles from the foot of the hills, on February 5th, 1915. Mrs. A. A. Barnard saw a few in Imphal in July, 1932. Three green pigeons, unidentified but probably of this species, were shot near the foot of the eastern hills on March 8th, 1920.

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[1] *Indian Pigeons and Doves*, pp. 8, 18.
[2] *J.B.N.H.S.*, vol. xxxiv, No. 2, p. 340.
[3] *J.B.N.H.S.*, vol. xxv, No. 1, p. 90.

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The Thick-billed Green Pigeon (*Treron curvirostra nipalensis*).

This species is not uncommon in the hills. On March 23rd, 1918, I saw a number of flocks in the jungle surrounding a village in the eastern hills, at 4,200 ft. There was no doubt as to the identification, as a sepoy shot one the previous evening.

The Pin-tailed Green Pigeon (*Sphenocercus apicaudus*).

This species is not uncommon and has been shot in the hills.

The Orange-breasted Green Pigeon (*Dendrophasa bicincta bicincta* or *prætermissa*).

Mr. A. A. Barnard, I.S.E., saw a pair at Kanglatongbi, at the foot of the hills in the north of the valley, in July, 1932.

The Wedge-tailed Green Pigeon (*Sphenocercus sphenurus sphenurus*).

I have never seen or heard of this species in Manipur, though from Baker's[1] description of its habitat there seems to be no doubt that it must occur.

The Green Imperial Pigeon (*Muscadivora ænea sylvatica*).

Baker[2] says that this species is 'a bird of the hills and plains alike . . . in Assam and Burma'. It does not occur in the Manipur valley and I have never seen it in the hills. But it is common in the Kabaw and Jiri valleys, on the Burma and Cachar borders of the State, and also in the Nambar forest, at the foot of the Naga Hills on the north.

The Grey-headed Imperial Pigeon (*Ducula badia griseicapilla*).

Baker[3] rightly says of the Manipur birds that 'though somewhat intermediate', they are nearest to *griseicapilla* and not to *insignis*. This species is fairly common in the hills, and one meets it frequently in *jhums*, on the march when one has no gun. I only once saw a large flock, of about 30, on November 22nd, 1931, in the south-western hills, at about 3,500 ft.

The Bronze-winged or Emerald Dove (*Calcophaps indica*).

This species is fairly common in the western hills, where it finds the evergreen forest which it likes. I have never noticed it in the eastern hills, though it may occur there.

The Ashy Wood-pigeon (*Columba pulchricollis*).

On July 17th, 1926, I saw three large grey pigeons (not the Grey-headed Imperial Pigeon) in a small thicket of mixed pine and evergreen forest, on the upper slopes of the high range west of the Manipur valley, at 5,100 ft. I heard the call of the same

[1] Op. cit., p. 82.
[2] Op. cit., p. 94.
[3] *Fauna of British India*, vol. v, p. 204.

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bird in the same place on July 2nd, 1927. From Baker's[1] description of their calls, it seems probable that these birds belonged to this species and were not the Speckled Wood-pigeon (*Dendrotreron hodgsoni*).

The Indian Rufous Turtle-dove (*Streptopelia orientalis meena*)—Manipuri, *khunu chaphubi* ('the pot pigeon', alluding to the likeness of their colouring to that of a red earthenware pot, burnt blue in patches) or *leimā khunu* ('the goddess pigeon').

This species is fairly common. It frequents the Residency garden in flocks during the rains, beginning to appear about the end of May.

The Malay or Burmese Spotted Dove (*Stretopelia chinensis tigrina*)—Manipuri, *khunu hawaimān* ('the spotted pigeon').

Very common in the Manipur valley and lower hills. I have never examined them to see whether they are *tigrina* or *suratensis*. Baker[2] says that the Manipur birds are 'intermediate between *suratensis* and *tigrina*', but 'nearer the Burmese than the Indian form'.[3]

The Burmese Ring-dove (*Streptopelia decaocto xanthocycla*)—Manipuri, *khunu halamān* (Hindu), or *khunu gurumān* (Muhammadan): I am informed that these names are both derived from the sound of the bird's call.

This species is common in the Manipur valley, especially near the foothills. An albino specimen was shot by Mr. C. Gimson, I.C.S., on December 26th, 1925.

The Burmese Red Turtle-dove (*Oenopopelia tranquebarica humilis*)—Manipuri, *wā khunu* ('the bamboo pigeon'). It is curious that the term 'bamboo-pigeon' is applied to *Streptopelia orientalis meena* in Bengal,[4] as I can confirm.

These little doves are common in the Manipur valley. They are found in flocks on the grazing grounds at the end of the rains, and collect in very large parties in the cold weather. They are very fast fliers, and I have had excellent sport shooting them when driven over bamboos at the corner of a village.

The Bar-tailed Cuckoo-dove (*Macropygia unchall tusalia*).

I have only seen one in Manipur, in a glen off the Manipur valley in the south-west.

II

Mammals.

Big game is scarce in Manipur. The Manipur valley is too thickly populated and deforested to hold many wild animals. In

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[1] *Indian Pigeons and Doves*, pp. 158, 175.
[2] *Fauna of British India*, vol. v, p. 243.
[3] *Indian Pigeons and Doves*, pp. 205, 211.
[4] 'Vertebrates of Jalpaiguri District', (Inglis, Travers, O'Donel and Shebbeare), *J.B.N.H.S.*, vol. xxvii, No. 1, p. 153.

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the hills, the Kukis—the 'scourge of God' as far as wild animals are concerned, have completely killed off a number of species since they migrated northwards into the State a little over a century ago, and have greatly diminished the rest.

The Elephant (*Elephas maximus*)—Manipuri, *sāmu* ('the black animal').

The Elephant was formerly common in the hills, and the Maharajas used to run kheddahs: the last of which I can find any record appears to have taken place in 1872, when 21 were caught in the Leimatak valley, which is the next valley to the west from the Manipur valley. In 1913 I saw the skull of an elephant in the house of a Kuki Chief, which had been shot by him some years before in the valley of the Khuga river, which flows into the Manipur valley from the south-west. Now the only elephants in the State are a very few in the extreme north and north-west, adjoining the Naga and North Cachar Hills, and in the foothills adjoining the Kabaw valley of Burma, in the south-east. The only one recorded in the Game Book since 1910 was shot in the Kabaw valley, where they are fairly plentiful.

The Javan Rhinoceros (*Rhinoceros sondaicus*)—Manipuri, *sāmu gandā* ('black animal rhinoceros').

Now only found as an occasional straggler, the rhinoceros was formerly not uncommon in suitable localities in the hills. I saw a skull in 1913, in the house of a Kuki Chief, which he had shot in the valley of the Khuga river. In the past 20 years, 2 or 3 have been killed by Kukis in the lower valley of the Barak, near Tipaimukh, on the Lushai Hills border. These were probably stragglers from the North Lushai Hills. I have never had an opportunity of ascertaining with certainty to what species these belong, but they are probably *sondaicus*.

The Gaur or Indian Bison (*Bibos gaurus*)—Manipuri, *lamsan* ('wild cattle').

The bison was formerly found throughout the hills, but now occurs only in the mountainous forests of the headwaters of the Jiri and Makru rivers, near the North Cachar border, and in the foothills above the Kabaw valley. Tradition has it that a pair always resides in the wild uninhabited country on the lofty Laikot range, between the Barak and the headwaters of the Irang, in the north-western hills. Some years ago one wandered across the eastern hills from the Kabaw valley or Somra, into the valley of the Thoubal river, two marches east of Imphal. The bison is not very common, even in the Kabaw valley. Colonel Wilson[1] records that they 'had existed in the State in fair numbers, but were practically wiped out by foot and mouth disease in 1896'. No doubt the Kukis helped.

[1] Op. cit., p. 182.

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The Gayal or Mithun (*Bibos frontalis*)—Manipuri, *sandang*.

Lyddeker[1] says that 'there has been much discussion as to whether the Gayal or Mithun is a truly wild animal or only a domesticated breed'. There is, I think, no doubt whatever that it is the latter, derived from the Gaur, with a strain of domestic cattle. The Gayal is kept as a domestic animal by hill men throughout the Manipur State, as well as elsewhere in Assam and Burma. Notes regarding it were published in the Journal recently by Mr. Livesey[2] and myself[3]. Since then, I have seen an entirely white Gayal and have heard of another.

The Bantin or Tsaing (*Bibos banteng*)—Manipuri, *santhou*.

Lyddeker[4] claims that the Tsaing 'occurs in the Manipur district, especially in the Kubbu (Kabaw) valley, between Manipur and Northern Burma'. As a matter of fact, this species now only occurs in Manipur as a straggler in the foothills above the Kabaw valley, where it is plentiful. But this valley is now wholly in Burma, although it was a part of Manipur prior to 1834, when it was ceded to Burma. The Tsaing formerly penetrated further into the State, as in 1913 I saw a head in the house of a Kuki Chief, which he had shot some years before in the Khuga valley.

Lyddeker puts forward the theory that the 'Manipur Bantin', meaning the Kabaw valley animal, may be a distinct subspecies from the Burma Bantin. On this I can express no opinion, having had no experience of any but the Kabaw Tsaing, but the description of the Kabaw bulls given by Colonel Wood, which he quotes, is correct.

The Indian Buffalo (*Bubalus bubalis*)—Manipuri, *iroi* ('the swimmer').

The wild Buffalo does not occur at all in the Manipur State, and there is no historical record or tradition of its occurrence. I mention the animal because, as Lyddeker[5] quotes the Manipuri name, it might be inferred that the animal is found wild in Manipur.

The Serow (*Capricornis sumatrensis rubidus*). I can find no Manipuri name.

The Serow occurs throughout the hills. I have never shot one and have only seen one skin. But from enquiries it seems certain that only one form occurs—*C. s. rubidus*. This is confirmed by the observations of Moggridge[6] with regard to the Upper Chindwin, on the east, and of Mackenzie with regard to the Upper Chindwin[7]

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[1] *The Game Animals of India* (1924), p. 64.
[2] *J.B.N.H.S.*, vol. xxxv, No. 1, p. 199.
[3] *J.B.N.H.S.*, vol. xxxv, No. 2, p. 444.
[4] Op. cit., p. 73.
[5] Op. cit., p. 83.
[6] *J.B.N.H.S.*, vol. xix, No. 4, p. 981.
[7] *J.B.N.H.S.*, vol. xxii, No. 4, p. 790.

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and the Chin Hills,[1] to the south. In the Naga Hills also, to the north, Mills[2] ascribes the serow to this subspecies.

The Goral (*Nemorhaedus griseus*)—No Manipuri name.

This animal only occurs on three contiguous ranges in the south-western hills, Tonglon, Lungthul and Songchal (83 H, BC4) in the valley of the Tuivai river. Leddeker[3] gives no indication of which species occurs in Manipur, saying that *N. hodgsoni* is 'said to occur in the Naga Hills, and *N. griseus* in Upper Burma. Pocock[4] says that the Naga Hills specimen was probably *griseus*, to which subspecies he ascribes the Goral of the Lushai Hills to the south-west of Manipur and the Chin Hills to the south, which districts are only separated from the locality where the Goral is found in Manipur by the Tuivai river and its tributary, the Tuikui. I have never shot a Goral myself, but have seen them, including dead animals shot by Kukis. These appeared to correspond to the description of *cinereus*.

The Sambar (*Rusa unicolor*)—Manipuri, *sajan*.

The Sambar of Manipur, which is not uncommon in the hills and in the glens running off the Manipur valley, belongs to the subspecies named *equinus* by Lyddeker,[5] being of the Malay variety. The heads are, as a rule, not large, even for the Malay Sambar. I have seen two instances of abnormal horns, both brought in by hillmen. In the first, of which I have not preserved the measurements, the right horn was normal; but the left horn had five points, with a tine as long as the brow tine and between it and the beam, and also a tine as long as those of the crowning fork and between them. This head was unusually massive. The second is an extraordinary head, with six points on the right and four on the left horn. The length of the right horn is $25\frac{1}{2}$ in., and of the brow tine $10\frac{1}{8}$ in.; the forked tines at the end of the horn are short—$1\frac{3}{8}$ in. and $4\frac{7}{8}$ in.; but inside the beam and the brow tine, growing from the burr, are a second beam, $18\frac{1}{2}$ in., and a second brow tine, 4 in.; while between the main beam and main brow tine is a short sixth tine, $3\frac{5}{8}$ in. The burr measures $12\frac{5}{8}$ in. in circumference. The left horn measures $30\frac{1}{4}$ in. in length, with the rear tine of the fork $10\frac{1}{2}$ in. and the front tine $15\frac{3}{4}$ in.; the brow tine measures $18\frac{3}{4}$ in.; halfway up the front tine of the fork, a tine of $3\frac{1}{8}$ in. juts backwards towards the rear tine; there is a small rudimentary tine on the inside of the brow tine, not sufficiently large to count as a point; the burr is 11 in. in circumference, and the beam is $10\frac{3}{8}$ in. in circumference just below the fork.

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[1] *J.B.N.H.S.*, vol. xxiv, No. 4, p. 762.
[2] *J.B.N.H.S.*, vol. xxix, No. 1, p. 228
[3] Op. cit., pp. 152, 154.
[4] *J.B.N.H.S.*, vol. xxii, No. 2, p. 316.
[5] Op. cit., p. 232

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The Hog Deer (*Hyelaphus porcinus*)—Manipuri, *kharisā*.

This species is not uncommon in the swamps in the south of the valley, the grassy tracts at the foot of the hills surrounding the valley, and the glens running off it. The heads are small.

The Manipuri Muhammadans hunt the Hog Deer in bands, consisting of mounted men armed with polo sticks and men on foot armed with spears, accompanied by trained dogs.

The Panolia or Eld's Deer (*Rucervus eldi*)—Manipuri, *sangai*: not '*sangnai*' or '*sangrai*', as in Lyddeker[1] and Oldfield Thomas.[2]

This species is found in the swamps and bogs in the south of the Manipur valley, and nowhere else in the State; incidentally, the whole valley is not 'one huge swamp', as Lyddeker[3] says. In the swamps it is fairly common, but, although nominally preserved by law, its numbers have decreased in late years, owing to the attentions of wild dogs and poachers. In times of high flood the wretched animals are driven out of their haunts to isolated pieces of high ground, where the neighbouring Nagas and Muhammadans take heavy toll, regardless of sex, age, close season or the rules directing the taking out of licenses to hunt them.

The best heads shot since 1910 are those recorded in the Journal,[4] bagged by Major-General H. C. Tytler (52 and 53 in., including the brow-antler), and by Jemadar Bahadur Khan, 17th. Infantry (53¼ in.).

The Muntjac or Barking Deer (*Muntiacus muntjak*)—Manipuri, *saji*.

This species is very common throughout the hills, and is found also in the isolated low hills and ranges in the valley itself, wherever they are sufficiently wooded. I have never examined the Manipur animals, with a view to determining whether they are *vaginalis* or *grandicornis*. Lyddeker[5] puts them down as *vaginalis*, to which subspecies Mills[6] ascribes the Naga Hills specimens. But Wroughton[7] recoeds both subspecies as occurring in the Upper Chindwin district, *grandicornis* having been obtained from the Kabaw valley. It seems probable, therefore, that both may occur in Manipur.

The Indian Wild Boar (*Sus cristatus*)—Manipuri, *lamok* ('wild pig').

Pig are common in the hills. In the valley they occur in the grassy tracts along the foothills and in the swamps in the south.

The Tiger (*Felis tigris*)—Manipuri, *kei*, *keijao* ('big tiger').

Tigers are found throughout the hills, and very occasionally in the valley near the foothills. But they rarely venture far from

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[1] Op. cit., p. 251.
[2] *J.B.N.H.S.*, vol. xxv, No. 3, p. 363.
[3] Op. cit., p. 253.
[4] *J.B.N.H.S.*, vol. xxi, No. 2, p. 655.
[5] Op. cit., p. 259.
[6] *J.B.N.H.S.*, vol. xxix, No. 1, p. 229.
[7] *J.B.N.H.S.*, vol. xxiv, No. 2, pp. 308, 309, and vol. xxiv, No. 4, p. 773.

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the hills, as the Manipur valley is bare of forest, and, except in the swampy south, of heavy grass cover. Moreover, the Manipuris have an ancient organisation under which their villages are grouped into *keirups* or 'tiger-clubs', for the purpose of ringing and killing tigers as soon as they make their appearance.

Between 1910 and 1924 (when the system was abolished) rewards were paid to the hillmen for the destruction of 189 tigers.

The Leopard (*Felis pardus*)—Manipuri, *kabo kei* ('the Kabaw tiger').

Leopards are common throughout the hills and straggle into the low hills in the Manipur valley itself.

Between 1910 and 1924 rewards were paid to hillmen for the destruction of 595 leopards. Of these, about 380 passed through my hands, of which only 2 or 3 were black.

The Clouded Leopard (*Felis nebulosa*).

This animal occurs in the hills, but is uncommon.

The Golden or Bay Cat (*Felis temmincki*).

This cat also occurs in the hills, but is rarer than the previous species. I only remember seeing 2 or 3 brought in for the reward, in seven years.

The Leopard Cat (*Felis bengalensis*).

Not uncommon.

The Fishing Cat (*Felis viverrina*).

I have never seen this animal in Manipur, although it is fairly common in the Assam valley.

The Jungle Cat (*Felis chaus*)—Manipuri, *tokpā*.

Fairly common.

The Civet Cat (*Viverra zibetha*).

Rare; but a species of Palm Civet (*paradoxurus*), known in Manipuri as *moirāng sāthibi* ('the dirty animal from Moirang', a village in the south of the valley) is common.

The Wild Dog (*Cuon dukhunensis*)—Manipuri, *huithou*.

Not uncommon, in the hills and in the swamps in the south of the valley.

The Jackal (*Canis indicus*)—Manipuri, *lamhui* ('the wild dog').

Jackals are rare and do not multiply. They are said to have come up with the bullock carts, when the road through the hills to the Manipur valley from Assam was opened in 1896. Another tradition has it that a Political Agent who was administering the State during the minority of His Highness the Maharaja introduced missionaries, jackals and pleaders, in the interests of humanity. The Durbar have eliminated pleaders, but jackals and missionaries persist.

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The Himalayan Black Bear (*Selenarctos thibetanus*)—Manipuri, *sāwom*.

This bear is common in the hills: between 1910 and 1924 the hillmen claimed rewards for 2,480 bears, at least 99 per cent of which must have belonged to this species. I only know one instance of a bear being found in the Manipur valley. In September, 1912, when I was staying at Moirang, at the southern extremity of the Loktak lake, some Manipuri fishermen brought in a large bear which they had killed with their paddles, as it was swimming across the lake. It had been visiting Ithing, an island on which His Highness the Maharaja has a fruit garden, and was making its way back to the western shore, about two miles from the hills.

The Bruan or Malay Bear (*Helarctos malayanus*)—Manipuri, *sāwom*.

This species occurs in the hills, but is rare. In a note recently published in the Journal,[1] I estimated the percentage brought in for rewards as not more than 1 per cent of the bears.

The Sloth Bear (*Melursus ursinus*).

Though common in Assam, this species does not occur at all in Manipur.

The head 'Various and Big Game' in the records includes the waders noted on above, occasionally shot for the pot or purposes of identification, the game and other animals mentioned, and otters (Man., *sanamba*). The latter are common in the bils and rivers, and the Manipuris say that there are two varieties.

Hares do not occur in Manipur at all.

A few Gharial (*Gavialis gangeticus*) penetrate up the Barak river from Cachar, as high as Tipaimukh or a little higher. There are none elsewhere in the State.

(*The end*).

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[1] *J.B.N.H.S.*, vol. xxxv, No. 3, p. 673.

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SOME BEAUTIFUL INDIAN TREES.

BY

THE LATE E. BLATTER, S.J., PH.D., F.L.S. and W. S. MILLARD, F.Z.S.

PART XV.

(*With one coloured plate*).

(*Continued from page 37 of this volume*).

THE VARIEGATED BAUHINIA.

Popular names: Kachnar (Hind.); Kanchan (Mar.); Bodantham, Mandari (Tel.).

Bauhinia variegata Linn. Sp. Pl. (1753) 375.—*Bauhinia candida* Roxb. Fl. Brit. Ind. ii (1832) 318.—The name *Bauhinia* was given in honour of John and Caspar Bauhin, sixteenth century herbalists, the twin leaflets suggesting two brothers.—Belongs to the family *Caesalpiniaceae*.

Description: A medium-sized tree with dark brown nearly smooth bark. The young shoots are covered with a brown pubescence. The leaves, which are shed during the cold weather, are 4-6 inches long, as broad or broader than long, with a median cleft reaching from $\frac{1}{4}$-$\frac{1}{3}$ the way down into the blunted lobes. When young they are minutely hairy but with age this character is lost except along the nerves and their axils, their texture is slightly leathery, the base is usually deeply heart-shaped, there are 11-15 nerves; the stalks vary from 1-1$\frac{1}{2}$ inches long. The flowers are large, fragrant, white or purplish, appearing when the tree is leafless, they are disposed in short, few-flowered, grey pubescent racemes at the ends of the branches or in the axils of the leaves, the flower stalks are short or absent with bracts and minute bracteoles which are slightly hairy and deltoid in shape. Calyx tube slender $\frac{1}{2}$-1 inch long, the limb spathe-like, as long as the tube and 5-toothed at the apex, softly grey-haired. Petals 2-2$\frac{1}{2}$ inches long, obovate, with long rather broad claws, all white or 4 petals pale purple and the fifth darker with purple veins. Stamens 5 fertile, no staminodes. Ovary softly hairy along the sutures, long stalked; style long; stigma head-like. Pod 6-12 by $\frac{3}{4}$-1 inch, hard, flat, dehiscent or a hairless stipe 1 inch long. Seeds 10-15.

This beautiful tree has flowers of varied colours, pink white and mauve splashed with purple. The white flowering form (*candida*) is also common and is very striking with a yellow splash at the base of one or more petals. These trees flower from December to March or April. Mr. C. M. Tambe, Superintendent of

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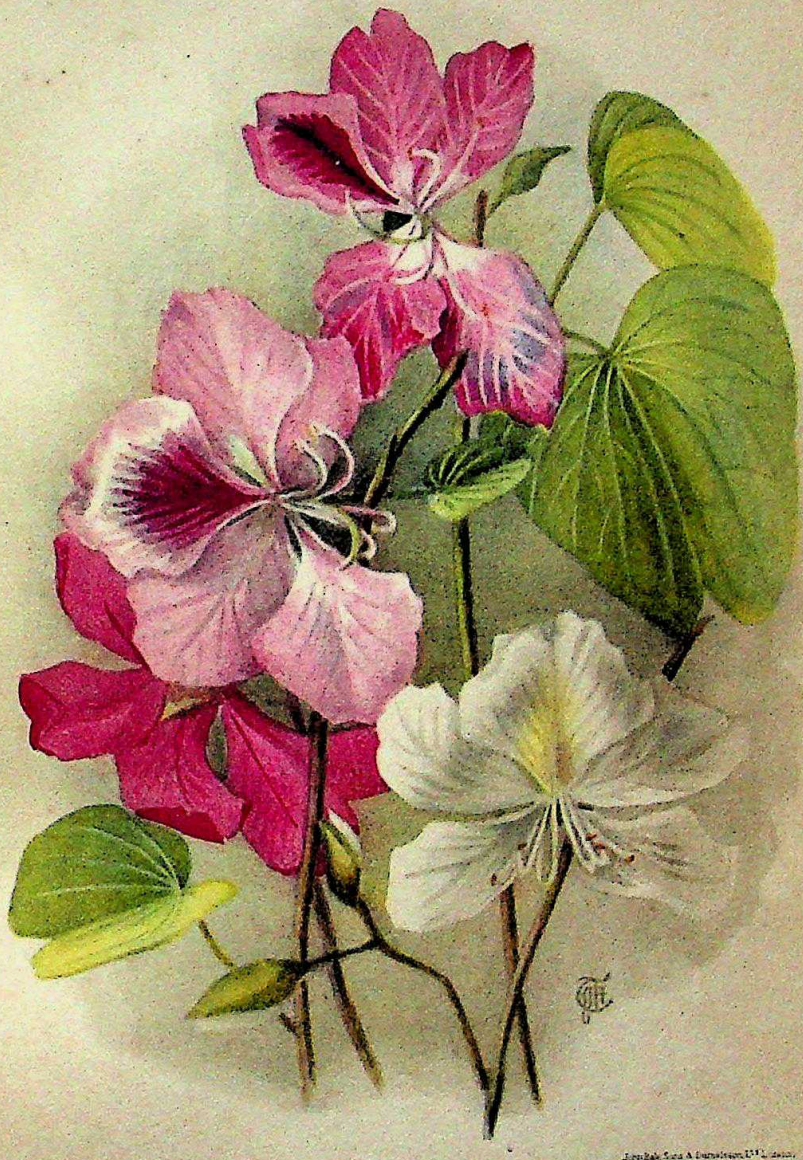

VARIEGATED BAUHINIA.
Bauhinia variegata Linn.
(about ½ nat. size.)

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H. H. The Maharaja Holkar's garden at Indore, The Manik Bagh, says: 'this tree is planted largely there in gardens and avenues for ornamental purpose.'

Distribution: Found wild in the sub-Himalayan tract from the Indus eastwards, Assam, Burma, Chota Nagpur, C. Provinces, W. Peninsula. Cultivated largely.—Wild also in China.

Gardening: Often cultivated in gardens and will sometimes flower in its second year as a shrub. It thrives in a variety of soils. They delight in high well-drained land. It is very tender and easily affected by low temperatures. No particular care in tillage or fertilizing is necessary, but better bloom is secured if some attention is given to these details. Cuttings root with difficulty.

Flowering, Leaf-shedding and Fruiting: The leaves commence falling in November to December, and the tree is leafless or nearly so by March; the new leaves appear in April and May. The large pink to purple or white flowers appear from February to April, chiefly on the upper leafless branches, the lower branches often being still in leaf. The flowers are fragrant and are visited by bees, by whose agency pollination is effected. The pods form rapidly, ripening in May and June (Northern India); they are 6-12 inches by $\frac{7}{10}$–1 inch, hard and flat, with 10-15 seeds, and dehisce for the most part on the tree, scattering the seeds. The seeds are $\frac{1}{2}$-$\frac{3}{4}$ inch by $\frac{1}{2}$–$\frac{7}{10}$ inch, nearly circular, flat, brown, with a somewhat coriaceous testa, 70-100 weighing 1 oz.; they germinate readily and show a high percentage of fertility, which is retained to some extent for at least a year. (Troup).

Natural reproduction: The seeds, which are scattered before the beginning of the monsoon, germinate readily when the rains begin, and germinating seeds may be found in quantity round the trees. But unless the seed happens to become buried in earth and debris, or is sheltered from the sun, most if not all of the young plants may die off owing to the drying up of the radicle if exposed to the sun, while birds and insects also cause a good deal of mortality by eating off the radicles. The most favourable condition for the establishment of reproduction appears to be the presence of loose porous well-drained soil, in which in the first place the seed has a chance of becoming covered with earth, and in the second place the seedling develops sufficiently rapidly to overcome weed-growth. (Troup).

Artificial reproduction: The most successful means of raising the tree artificially is by sowing in lines in which the soil has been well loosened, followed by regular weeding and loosening of the soil. Unless regular watering can be carried out, transplanting is difficult except in the case of small plants during the first rains. The seed should be sown in May in drills 9-10 inches apart; the young plants usually appear in 4-10 days, and may be transplanted while still comparatively small during the first rains. Trees planted for ornament may be kept a second year in the nursery, but regular watering is necessary in the dry season following transplanting; in this case either the seedlings should be pricked out in the nursery during the first rains or the drills should be at least

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12 inches apart, and the seedlings should be thinned out where necessary. (Troup).

Uses: The flowers and flower-buds are eaten as a vegetable. The wood is used for agricultural implements and for fuel. The bark yields a fibre and is both eaten and used medicinally. The bark is astringent, tonic and alterative, and a decoction is useful in diarrhoea. The flowers are laxative. The dried buds are also useful in diarrhoea and worms, and a decoction of the root is an anti-fat remedy. The bark is also used in tanning and dyeing.

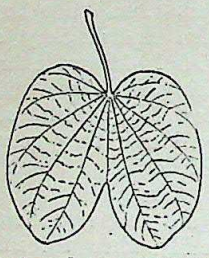
This tree can easily be mistaken for another beautiful tree often grown in Indian gardens.

The Purple Bauhinia.

Popular names: Khairwal, karar, koliar, kaniar (Hind.); Atmatti (Mar.); Sarul, baswanapada, kanchivala (Kan.); Kanchan (Tel.); Mahahlegani (Burm.).

Bauhinia purpurea Linn. Sp. Pl. (1753) 375.

Description: A medium-sized tree with nearly ashy to dark-brown bark, leafless during the cold season, young parts clothed with brown pubescence. Leaves 3-6 inches long, rather longer than broad cleft about half way down into 2 pointed or rounded lobes, very minutely hairy beneath when young, base usually heart-shaped, 9-11 nerved; leaf-stalks 1-1½ inches long. Flowers large, rose, purple, disposed in few-flowered panicles at the ends of the branches, the panicles are covered with a brown tomentum, stalks ⅛-½ inch long, stout and covered with a powdery substance; bracts and bracteoles small, tomentose, deltoid. Calyx tomentose, tube $\frac{3}{10}$–⅔ inch long, the limb twice as long as the tube usually splitting into 2 reflexed segments, one irregular margined, the other 3-toothed. Petals 1½-2 inches long, oblanceolate, long-clawed, spreading veined. Stamens usually 3 fertile, the others reduced to antherless filaments. Ovary downy, long-stalked, style long, stigma large and oblique. Pod 6-10 by ⅗–⅘ inch, on a tomentose style, ⅗–1 inch long, linear, flat, pointed, greenish tinged with purple till ripe, breaking up late. Seeds 12-15, almost round, flattened, ½ inch in diameter, dark brown, smooth.



It grows sparingly throughout India and China and is cultivated in most parts of India.

Flowering and fruiting: The terminal panicled racemes of large purple, deep rose to lilac flowers appear amongst the foliage from September to December. The flowers are very fragrant, and are visited by numerous bees, by whose agency pollination is effected. The pods form rapidly, some attaining a fair length while the tree is still in flower; they ripen from January to March, and are then greenish purple, 6-12 inches by $\frac{7}{10}$–1 inch, flat, fairly thick, pointed, slightly falcate, with coriaceous valves, containing 10-15 seeds. The seeds are brown, compressed, ⅗ by ½ inch. They germinate readily and have a high percentage of fertility,

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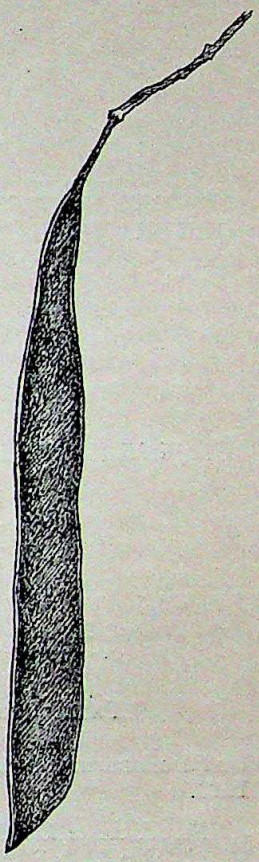
which they retain unimpaired for at least one year; tests at Dehra Dun with seed kept for 14 months showed a fertility of 100 per cent. The pods dehisce on the tree during the hot season, scattering the seeds. (Troup).



Natural reproduction: The seeds germinate readily at the beginning of the rains, when numerous young seedlings may be found in the neighbourhood of seed-bearers. Where germination takes place on the surface of the ground, however, much mortality takes place owing to the drying up of the radicle if exposed to the sun. The survival of the seedlings is greatly facilitated if the seed becomes buried in loose earth before germination and the roots of the young plant are not exposed. (Troup).

Artificial reproduction: Experiments at Dehra Dun have shown that the best results are attained by line sowings kept regularly weeded; irrigation also has a marked effect on the growth. The seedlings are somewhat sensitive to transplanting, which has to be done with care. The seed should be sown in the nursery in April or May in drills 9-10 inches apart, and covered to a depth of about a quarter of an inch, regular watering and weeding being carried out. The seedlings appear in about 4-10 days, and can be transplanted while still of small size during the first rains. Transplanting with unpruned stem and roots should not be attempted during the second rains unless regular watering is possible for some time. A certain amount of success has been attained by transplanting after pruning the stem and taproot down to 2 and 9 inches respectively, but this checks the growth severely for a time. (Troup).

(*To be continued*).

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THE PALM CIVETS OR 'TODDY CATS' OF THE GENERA *PARADOXURUS* AND *PAGUMA* INHABITING BRITISH INDIA.

BY

R. I. Pocock, F.R.S.,

Unofficial Assistant of the British Museum (Natural History).

PART III.

(*With 3 text-figures*).

(*Continued from page* 192 *of this volume*).

PARADOXURUS HERMAPHRODITUS RAVUS, Miller.

Paradoxurus ravus, Miller, *Smiths. Misc. Coll.*, lxi, p. 21, 1913.

Paradoxurus hermaphroditus laotum, Gyldenstolpe, *K. Sv. Vet. Akad. Handl.*, lvii, No. 2, p. 26, pl. iv, figs. 2-4, 1917 (February); and *Journ. Nat. Hist. Soc. Siam*, iii, p. 147, 1919; Robinson and Kloss, *Rec. Ind. Mus.*, xix, p. 179, 1920.

Paradoxurus birmanicus, Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xxiv, p. 51, 1917 (March).

Locality of type of ravus: Trang in Peninsular Siam (Lat. 8°N.).

Locality of type of *laotum*: Chieng Mai in N. Siam (said to be Laos).

Locality of type of *birmanicus*: Mingun, W. of Sagaing, Upper Burma.

Distribution: From Indo-China, N. Siam and Upper Burma southwards through Tenasserim to the northern Malay Peninsula.

Note on the synonymy: Miller briefly described a subadult ♂ and an adult ♀ (type) of *ravus* from Trang as distinguishable from

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the southern Malayan and Sumatran race, *musanga*, which he called *P. hermaphroditus hermaphroditus*, by having the ground colour of the upper parts noticeably paler (about pale-ecru drab) instead of brownish ochraceous tawny, so that the black spots and hair tips are thrown into greater contrast. This description and the flesh measurements of the type, as well as the measurements he gave of the two skulls, agree so closely with some examples Shortridge collected in Tenasserim Town that I do not doubt Wroughton correctly identified the latter as *ravus*. But these Tenasserim specimens are indistinguishable from a large series of specimens in the British Museum ranging from Pegu northwards to Sagaing in Upper Burma, whence the type of *birmanicus* came, the character upon which Wroughton relied for the separation of *birmanicus* from *ravus*, namely the blackness of the crown between the ears, being of no systematic importance since it varies profoundly in the same locality as shown below, more particularly in the series of skins from Toungoo. But Byldenstolpe claims that *birmanicus* is unmistakably synonymous with the race from N. Siam, or Laos, which he called *laotum;* and this name has a month's priority over *birmanicus*. Glydenstolpe's verdict on this point has been generally accepted and there are reasons for believing it to be correct, although his type is a little larger in skull and body than any of the Burmese specimens I have seen.

Description: Resembling *pallasii* in having the pattern of dorsal stripes and lateral spots distinct throughout the year, but in the winter coat the wool is shorter and altogether less luxuriant, and the long hairs are a little longer so that the coat is more shaggy; the ground colour, also, in a great majority of cases is grey sometimes clear, generally slightly or moderately buffy, very rarely exhibiting the richer ochreous buff hue which is common in *pallasii*, hence the pattern stands out more boldly in contrast with the paler interspaces; the brow-band is noticeably more conspicuous than in the Indian races and not subdivided by black speckling except occasionally in the middle line (Fig. 1, C, vol. xxxvi, p. 870). In the adult skull the postorbital processes are on the average smaller, and the external pterygoid crest larger; the teeth also are larger, pm^4 and m^1 having their inner portions better developed in a great majority of skulls; and in the female at least the sagittal crest, as a rule, is formed earlier while the milk dentition is still in use.

The distribution of this race from north to south in British Burma corresponds very closely in latitude with that of typical *hermaphroditus* in Peninsular India. Not surprisingly the two are tolerably similar as regards the growth of the underwool and the comparative shagginess of the coat owing to the relatively long overlying hairs. But these hairs are not so long in *ravus* and have far less extensive black tips, so that the pattern is not concealed, when the coat is fully developed, as it frequently is to a less or greater extent in the Indian race. Only very exceptionally too is that of *ravus* which, when unaffected by the moult, is a marked

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the brow-band of *hermaphroditus* matched in conspicuousness by facial feature.

In addition to a few unmeasured and mostly undated specimens from one or two localities in Burma, the Museum contains good series of examples collected for the Mammal Survey in Upper and Lower Burma and Tenasserim.

Mingun, W. of Sagaing in Upper Burma. Three adult or sub-adult moulting suckling females, including the type of *birmanicus*, and three immature skins (*G. C. Shortridge*), July 9-13. The general colour varies from tolerably uniform ashy grey to buffy grey and the pattern is distinct in all; the brow-band may be uniformly pale grey or mesially infuscate and in one example (No. 3316) it is completely divided by a black line 9 mm. wide but expanding above to 25 mm., where it passes into the black crown. The type (No. 3261) also has the crown black, the back clear ashy grey, without buff tinge, and the interspaces well defined owing to the scantiness of the black speckling; the forequarters are darker grey owing to more extensive black pigmentation.

In another (No. 3252) the crown is black except for a conspicuous median white line; but in No. 3336 the median third of the crown is speckled with grey, forming a band connecting the brow-band with the nape. The phenomena of coat change exhibited by these skins are described above (p. 315).

The three immature skins, with the head and body measuring about 14 in., resemble the older ones but show no signs of moulting either the long coarse hairs or the under fur. Three kittens, with the head and body about 10 in., were also collected; the coat is soft and furry with the pattern distinct, and the general colour varying, one being dull buffish grey, another less buffy and blacker, the third blacker still.

Another example from the same locality, a ♀ (No. 10.9.15.4) nearly full size but still with milk dentition, was collected by Major Harrington on January 11th. The winter coat is about as long as in the September examples but has abundant underwool. The ground colour is mostly clear, whitish grey, with at most a faint buff tinge, but the copious black tipped hairs rather obscure the pattern, the dorsal surface presenting a somewhat marbled black and white pattern. The black of the crown is mesially speckled.

Lower Chindwin. Several specimens collected by G. W. Dawson and given to Shortridge. Three flat native skins from Thayagon in the Budalin district, dated, but unreliably, August 20th, resemble the Mingun skins in having the coat long and shaggy, with little underwool, the general tint varying from clear to buffy grey and the crown either black or mesially speckled. An adult suckling ♀, June 4, also has the coat long and thin with no perceptible underwool, the general colour ashy grey, hardly obscured by black speckling, but with a slight buff tinge especially on the hind-quarters, the nape with a good deal of grey and the crown mesially speckled. A flat unmeasured ♂ skin from Yin in the Nani town-

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ship, November 5th, has the coat thickened with plenty of underwool and the ground colour a rich ochreous buff, much brighter than the majority of examples of *ravus* and resembling the bright Assamese examples of *pallasii*, but at once distinguishable by the conspicuousness of the frontal band; the crown is mesially speckled.

Mt. Popa, 4,961 ft., some 70 miles S. of Lower Chindwin. Half a dozen examples, mostly young, collected by G. C. Shortridge between September 3 and 28. Closely resembling the Mingun and Lower Chindwin specimens dated June and July, but with plenty of underwool, the coat being nearly as full as in the January skin from Mingun, and with a rather more extensive range in colour, the extremes being an adult ♀ (September 28), in which the interspaces on the back are clear whitish grey, hardly dimmed by black speckling and emphasising the pattern, with the crown black and the nape more heavily pigmented, as in the type of *birmanicus;* and a young ♂ (September 3), which is considerably darker, almost brown, by comparison owing to the interspaces being almost ochreous buff, but dimmed by the extreme black pigmentation of the hair-tips so that the distinctness of the pattern is obscured. The other skins are more or less intermediate between these two.

Toungoo. About a dozen adult and young adult specimens collected by J. M. D. Mackenzie, 6 miles E. of the town, 100 ft., and from 20 to 30 miles N. and N.-W. of it, 500 ft., between September 10 and 19, February 3 and 29, March 2 and 27. The colour and pattern on the average are the same as in the Mingun, Chindwin and Mt. Popa specimens, clear ashy to buff grey and the crown similarly varies, being either black or mesially speckled with grey in the same month of the year. The two extremes are a young adult ♂ (No. 1341), September 11, in which the coat is short, about 30 mm., the general colour dull olive grey, with the pattern well defined, the stripes coalescing on the shoulders and blackening them, the nape black in the middle, speckled black and greyish buff on the sides, the crown jet black; and a subadult ♂ (No. 1463), March 2, in which the coat is longer, about 40 mm., the general colour pale buffy grey, the hairs having whiter, more extensive pale areas, and less black at their tips, the pattern less well defined owing to the longer coat, the shoulders and nape grey, speckled with black and the crown thickly speckled with grey as far externally as the small black patch at the base of the ears. There is also an adult ♀ skin and skull from Toungoo (*Wardlaw Ramsay*, No. 79.11.20.1), with harsh, thinnish summer coat, with the moult imminent, and large isolated teats; the general colour is dull buff grey on the hind back and rump, darker, blacker grey forwards; the crown from between the ears is entirely black and the pattern of stripes and spots is well defined.

A young ♀ belonging to Mackenzie's lot, January 29, is of interest on account of its bright yellowish buff ground

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colour, like the skin from Yin in Lower Chindwin, both above and below.

A young ♂ from the northern Zamayi Reserve, 80 miles N. of Pegu town (*J. M. D. Mackenzie*), April 30, is interesting from the effects of the moult upon the coloration. The coat is short, thickish without long hairs, the general tint faded greyish buff, the pattern brownish and ill-defined, and the head from between the eyes, the neck and forequarters uniformly dull brownish grey, the white and black tipped hairs, which normally make a contrast between the grey frontal band and the darker crown being alike absent. When in fresh coat this specimen probably resembled the young brightly coloured example from Toungoo.

An adult ♀ from Kyeikpadam in Lower Pegu (*E. W. Dates*), August 25, has the coat harsh and long, about 46 mm., with scanty underwool, the general colour closely resembling that of the normal more northern specimens, dark ashy grey with a wash of a buff on the back and rump and the pattern well defined.

A skin, without date or other particulars, from Wimpong, Thatone, 52 miles N.-W. of Moulmein (*W. Davison*), has the coat thick and full, about 38 mm. long, the colour is brighter buff than in the specimen from Lower Pegu and unmistakably resembles that of the brightly tinted skin from Yin in Lower Chindwin. In patches the hairs are quite yellow from fatty secretion from the skin.

Tenasserim Town. An adult ♀, March 5, and two subadult ♂, March 14 (*G. C. Shortridge*). The ♀ (No. 4886) has the coat longish, with scanty underwool, the general colour ashy grey above and below, with a faint tinge of buff on the mid lumbar region (? due to dorsal gland), the neck darker grey than the back, the crown conspicuously grizzled mesially, the coloration very like that of many of the more northern Burmese specimens. One of the ♂ specimens (No. 4907) is darker than the ♀ owing to a decided buff wash on the back and flanks, and to the dorsal interspaces being more extensively speckled by the black tips of the hairs. This skin closely resembles the one from Lower Pegu but is a little buffier. The other ♂ (No. 4937) is, on the contrary, decidedly lighter than the ♀ and shorter coated, the general colour is not so ashy, rather creamy greyish white, the pale hue of the dorsal interspaces being more extensive and the black tips to the hairs less in evidence, so that the pattern is more emphatic; the nape is also much paler and the crown more extensively speckled both on its individual hairs and externally towards the ears. This skin almost exactly matches the pale skin from Toungoo (No. 4937).

The difference between these skins shows that the coloration of *ravus*, if I am right in assigning them to that race, is more variable than Miller's description of the specimens from Trang suggests. Similar variations, in my experience, are exhibited by all continental races of *Paradoxurus hermaphroditus*.

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In the following table of flesh measurements the specimens are arranged geographically from north to south.

Locality, Date and Sex.	In English Inches. Head and Body.	Tail.	Hind Foot.	Weight.	Coat in mm.
Mingun, W. of Sagaing (3316) July 13. ad. ♀	22⅘	19⅘	3⅜+	6¾ lbs.	38
Mingun, (*birmanicus*-type). July 9. ad. ♀	22⅘	20⅜	3⅜	7¼ ,,	41
Mingun (3252). July. ad. ♀	21⅜	20	3⅛	6½ ,,	...
Mingun (Harrington). Jan. 11, immat. ♀	20⅘	20⅜	3⅛	...	44
Kin, Lower Chindwin (5387). June 14. yg. ad. ♀	24⅜	21	3⅜	7½ lbs.	46
Thayagon, Lower Chindwin (3905), Aug. 20. ad. ♀	20	19½	3+	...	46
Mt. Popa (3901). Sept. 28. yg. ad. ♀	22½	19⅕	3⅛	6¾ lbs.	46
,, (3883). Sept. 25. yg. ♂	20⅕	19	3⅜	5¾ ,,	40
Toungoo (1508). Feb. 23. ♂	23¼	18⅕	3⅜	...	41
,, (1341). Sept. 11. ♂	22⅘	23	3⅜+	...	30
,, (1340). Sept. 19. ♂	22+	21⅘	3⅜	...	34
,, (1474). March 27. ♀	22⅕	19−	3⅜	...	45
,, (1509). Feb. 23. ♀	23⅘	23	3⅜	...	40
Tenasserim Town. March 14. yg. ad. ♂	24+	20	3⅜	8 lbs.	36
Tenasserim Town, March 14. yg. ad. ♂	23⅜	18⅘	3⅜	7 lbs.	33
Tenasserim Town ; March 5; yg. ad. ♀	22	19⅕	3⅜	...	41
Trang, Penin. Siam. (*ravus* type) ad. ♀	23⅕	18⅘	3⅜	...	...

The following conclusions may be deduced from this table:— In general size *ravus* agrees with *pallasii;* the males and females are approximately similar in bodily size; individual variation in

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size at least in the females is considerable as attested by the two from Lower Chindwin, the young adult ♀ from Kin being nearly 6 in. longer from nose to tail-tip than the adult ♀ from Thayagon; Miller's type of *ravus*, despite its comparatively small skull, is only surpassed in dimensions by two of the Burmese skins. It is unfortunately impossible to estimate accurately the age of most of the Toungoo specimens because only one skull is available.

Locality and Sex.	In English Inches.					In Millimetres.		
	Total length	Zygom. width.	Waist width.	Int. orb. width	Max. width.	Bulla.	Pm^4	M^1
Allagappa, W. of Sagaing ; ad. ♂	4·5	2·7	·5½	·8½	·9	17	9 × 7	6½ × 8½
Legyi village, W. of Sagaing ; ad ♂	(4·4½)	2·7½	·5	·8	·8½	...	9 × 7	7 × 8
Mingun, W. of Sagaing ; ad. ♂	4·3	2·4	·4½	·8—	·8	17	9 × 7	6 × 8
Toungoo (1463) yg. ad. ♂	4·3	2·5	5⅓	·8	·8	18½	9 × 6½	6½ × 9
Kyeikpadam, Lower Pegu ; ? ad. ♂	(4·2)	2·4½	·5—	·7	·8	...	9 × 7	6 × 9
Tenasserim Town ; yg. ad. ♂	4·6	2 5	·4½	·7	·8⅓	17	9 × 7	6 × 8
,, ,, yg. ad. ♂	4·4	2·4	·4½	·7½	·8+	17½	9 × 7	6½ × 8—
Mingun (*birmanicus*-type) ad. ♀	4·4	2·3½	·5+	·7½	·8+	18	8½ × 7	6 × 8
,, (3316) ad. ♀	4·3½	2·4	·4	·8	·8	17	9 × 7½	6½ × 7½
,, (3252) yg. ad. ♀	4·1	2·2	·5	·7	·7+	17	9 × 7	6½ × 8
,, (Harrington) ; immat. ♀	4·0	2	·4½	·6	·7—	19	...	...
Thayagon, Lower Chindwin (3905) ad. ♀	4·3	2·4—	·4½	·7½	·8	17	9 × 7	7 × 8½
,, (3904) yg. ad. ♀	4·1	2·2	·5	·7	·7	18	8½ × 7½	6 × 7½
Kin (3903) ad. ♀	4·4	2·3—	·5	·7½	·7½	18	8½ × 6½	6½ × 8
Lower Chindwin (5387) yg. ad. ♀	4·4	2·2	·4—	·6	·8—	16½	9 × 7	7 × 9
Mt. Popa (3901) yg. ad. ♀	4·1½	...	·4½	·6¾	·7	18	9 × 7	7— × 8
Toungoo (Ramsay) ad. ♀	(4·4)	...	·5	·7	·7½	...	9— × 7	6½ × 8
Tenasserim Town ; yg. ad. ♀	4·4	2·4+	·4½	·7+	·8—	17	9 × 7	6½ × 8—
Tenasserim Town ; yg. ♀	4·1½	2·1—	·5	·6	·7	17½	...	6 × 8

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In general dimensions the skulls of *ravus* agree closely with those of *pallasii*, ♂ skulls being slightly larger than ♀. The teeth are on the average a little larger in *ravus*, especially in width, and are more variable in shape. Very commonly the inner surface of the upper carnassial (Pm^4) is provided with a distinct ledge (cingulum) passing obliquely from its anterior inner lobe to its

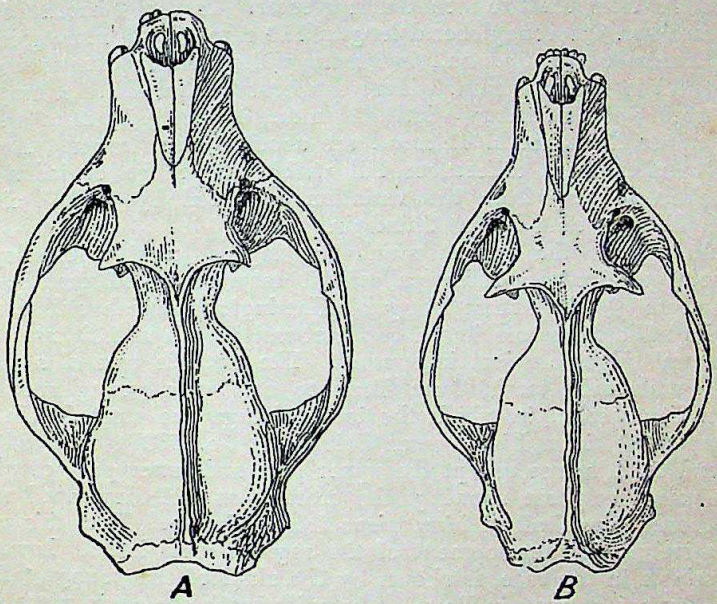

Fig. 5.—*A*. Skull of adult male of the Burmese race (*P. h. ravus*) from 30 miles west of Sagaing. *B*. Skull of adult male of the Lesser Palm Civet (*P. h. minor*) from Bankachon, Tenasserim. Figs. 2/3 nat. size.

posterior cusp, so that the tooth is more triangular in shape, with its inner surface not so deeply emarginate nor noticeably concave as in *pallasii* and other Indian races. But this ledge differs greatly individually in development. In the larger of the two ♂ skulls from Tenasserim Town, for instance, it is prominent; in the smaller it is absent, the tooth resembling in shape that of *pallasii*. The bullae also vary individually in length and shape. They are much larger, for example, in the immature ♀ skull from Mingun (Harrington) than in the young adult female from Kin in Lower Chindwin, these being the two extremes, with other skulls from Mingun intermediate. The inflation may also be very noticeably compressed or evenly convex. This difference is shown even in the small series from Tenasserin Town.

Since my identification of this Burmese series as *ravus* rests mainly on my belief that the specimens from Tenasserim Town are, as Wroughton thought, racially inseparable from Miller's specimens from Trang in Peninsular Siam, I may add that the smaller of the two young adult males from Tenasserim Town agrees very closely in its measurements with those recorded by

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Miller for his young adult ♂ from Trang. The condylobasal length of 109 mm. is 1 mm. longer, the zygomatic width 60½ mm. is about 2 mm. greater, the cranial width 35 mm. is the same, the int-orbital width 19 mm. is less than 1 mm. wider, the maxillary width 21 mm. is 1 mm. wider and the upper cheek teeth, excluding the incisors 41 mm. is 1 mm. less. The difference between the ♀ skulls from the two localities is greater. In the ♀ from Tenasserim Town the condylobasal length, 110 mm., is 5½ mm. greater; the cranial width, 35 mm., is 2 mm. wider; the zygomatic width, 62 mm., is nearly 4 mm. wider; the int-orbital width, 18 mm., is the same; the maxillary width, 20 mm., is barely 1½ mm. wider, the upper cheek teeth, 41 mm., are about 3 mm. longer. But in my opinion these differences fall within the range of individual variation judging from the variation exhibited by the ♀ skulls from Mingun and Lower Chindwin.

As regards the age at which the sagittal crest is developed, a point referred to under *pallasii*, it may be noted that in the immature ♀ skull from Mingun (Harrington), which still carries all its milk teeth and has a condylobasal length of 102 mm., the temporal ridges are just in contact. The same is true of a young male with milk teeth, from Toungoo and in a young specimen from Tenasserim, in which the tooth change has started. In the youngish ♀ from Kin, Lower Chindwin (No. 5387), with all the second teeth in use except the upper pm^3 and lower pm_4, of which the points only are showing, the crest is as well developed as in the adult type-skull of *birmanicus* from Mingun. That this comparatively early development of the sagittal crest is not, however, invariable in the race, is shown by the skull of the young ♂ from the Zamayi Reserve in Pegu. The milk teeth are all in place with m^1 through the bone, yet the temporal ridges are widely separated, 13 mm. apart on the parietals.

Paradoxurus hermaphroditus minor, Bonh.

Paradoxurus minor Bonhote, *Fasc. Malay. Zool.*, i, p. 8, 1903.

Locality of type: Kampong Jalor in Peninsular Siam.
Distribution: Malaya, Peninsular Siam, Tenasserim, ? Annam.

Distinguished from *ravus* by its smaller size, less robust dentition and by the inconspicuousness of the frontal band which, although variable in its amount of grey speckling, is not so sharply contrasted with the crown and there is no pale patch on the muzzle; the general colour also is typically much brighter although not brighter than in a few exceptional examples of *ravus*, but these may be distinguished from *minor* by their larger teeth and conspicuous brow-band and white patch on each side of the muzzle.

Two examples, collected in Tenasserim by G. C. Shortridge for the Mammal Survey, were originally identified by Wroughton as *Paradoxurus hermaphroditus* and subsequently as *P. ravus*. On neither occasion did Wroughton distinguish them from the

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examples collected at Tenasserim Town, also by Shortridge, despite the marked difference between them.

Bankachon, Victoria Point. Ad. ♂. December 17. Coat full and moderately long, about 35 mm.; ground colour of back and flanks rich ochreous buff fading in brightness on the fore quarters and everywhere overlain by the long black tips of the hairs which also render the pattern rather obscure; belly greyish brown with an ochreous wash; head brown with the frontal band merely represented obscurely by fine grey speckling; the blackness of the muzzle and cheek relieved only by the grey subocular spot; the throat, feet and distal three fourths of the tail black.

Thaget on the Little Tenasserim River. A young adult ♂; March 25. Closely resembling the last in general colour, but the nape of the neck not so dark and the frontal band better developed, consisting of a large patch of grey-speckled hairs on each side of the black middle line of the forehead, and the belly greyish brown without such noticeable ochreous wash.

Both in flesh-dimensions and cranial measurements these two specimens are a little larger than the type and examples from the Malay Peninsula I have seen; but the material is insufficient to justify the attachment of systematic importance to the differences.

The flesh measurements in English inches and weights of the two Tenasserim specimens and the measurements of the type are as follows:—

Locality and Sex	Head and Body	Tail	Hind Foot	Weight	Coat
Bankachon, Victoria Point; Dec. 17; yg. ad. ♂	19⅘	19	3+	4½ lbs.	35 mm.
Thaget, Little Tenass. River; March 25; yg. ad. ♂	19⅜	19	3	5¼ ,,	32 ,,
Jalor, Peninsular Siam (type); Nov. 3; yg. ad. ♀	18	18½	2⅜	...	26 ,

The following are the skull measurements of the same.

Locality and Sex	In English Inches: Total length	Zygom. width	Waist width	Int. orb. width	Max. width	Bulla	In Millimetres: Pm^4	M^1
Bankachon; yg. ad ♂	4·1	2·2	·4	·6½	·6¾	16	7½ × 5	6 × 7
Thaget; yg. ad. ♂	4·0	2·1	·5–	·7	·7	16	8 × 6	6 × 7
Jalor (type); yg. ad. ♀	3·7	2+	·4¾	·6½	·6	15	8 × 6	5¼ × 7

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The skull from Bankachon, with a condylobasal length of 98 mm., although still showing the occipital suture, is muscularly well developed, with narrow waist, complete sagittal crest, 4 mm. high on the frontals, and large postorbital processes measuring 31 mm. from point to point. In the two ♂ skulls of *ravus*, of about the same age, from Tenasserim Town, the processes are not only thinner and more pointed but measure 30 and 28 mm. across respectively, although the skulls are considerably larger. The skull from Thaget is a little younger and less well developed.

The typical ♀ skull, with a condylobasal length of 95 mm., is about the same age as the ♂ skulls but has no sagittal crest, the temporal ridges being separated throughout and 10 mm. apart on the parietals and the postorbital processes are 23 mm. from tip to tip. In this tardy advance of the temporal ridges this ♀ skull differs from ♀ skulls of *ravus* from Burma and resembles ♀ skulls of *pallasii* from Assam.

The dentition too of *minor*, pm^4 and m^1 lacking the development of the inner portion characteristic of *ravus*, is more like the dentition of *pallasii* and other Indian races.

From various islands of the Mergui Archipelago the following six subspecies were described by Miller (*Smiths. Misc. Coll.*, 61, pp. 3-5, 1913). I have seen no specimens from these islands and can only judge of these races, three of which were described from single specimens, from the analogy supplied by mainland races.

P. h. senex. Domel Isl. A single young adult ♂ distinguished from Miller's examples of *ravus* from Trang in Peninsular Siam by having less traces of yellow on the back and sides and greatly reduced auditory bullae which are slightly inflated and only 10½ mm. from the paroccipital process, not including it, as in my measurements. Miller himself was dubious as to the constancy of the colour difference; and in view of the variations between the three specimens of *ravus* from Tenasserim Town, no reliance can, in my opinion, be placed upon it. The bulla is small; but it is not clear where the measurement was taken: the bulla, of the bigger ♂ skull of *ravus* from Tenasserim Town is 10½ mm., measured from the process along its lower surface. In the other specimens it is 13 mm. Clearly more specimens are required from Domel Island to establish the validity of *senex*.

P. h. fuscus. James Island. A single adult ♀ described as differing from *senex* by its more extensive black markings and sooty brown underside. Both these colour-features are too variable individually in mainland forms to be trusted on the evidence of a single specimen.

P. h. pallens. Kisseraing Isl. A single adult ♂ differing from Miller's specimens of *ravus* by having the tail distinctly brownish instead of essentially black, its basal third being the same colour as the head and body and contrasted with its distal portion. In

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the examples I assign to *ravus* the tail is typically black, but in a few specimens it is deep brown in its terminal portion. Moreover in a large number of specimens the basal third of the tail above and below is like the back.

P. h. pugnax. Sullivan Island. Two specimens like *pallens* but slightly smaller and with the dark markings rather more extensive especially on the thighs, upper part of fore legs, nape and cheeks. Similar differences fall within the range of individual variation in the series I assign to *ravus*.

P. h. sacer. St. Matthew and St. Luke Islands. Five specimens like the Kisseraing specimen but with the stripes reduced and broken up into lines of spots and the skull smaller, the smallest from the Mergui Archipelago and scarcely exceeding that of *P. minor*. In none of the mainland specimens of *ravus* is the dorsal pattern disintegrated into spots.

P. h. pulcher. Clara Island. Two specimens like *pallens* of Kisseraing Island, but ground colour both above and below between cartridge-buff and cream-buff, more yellowish than in any of the other known races. It does not appear that these specimens differ in colour from *pallens* more than the very brightly tinted young example of *ravus* from Toungoo differs from typical grey specimens from that locality.

The flesh measurements in English inches of the types of these described Mergui races are as follows:—

Name, locality and sex		Head and body	Tail
Domel Island (*senex*)	yg. ♂	21	18⅜
James Island (*fuscus*)	ad. ♀	20	...
Kisseraing Island (*pallens*)	ad. ♀	21½	17
Sullivan Island (*pugnax*)	ad. ♀	20⅜	17—
St. Matthews Island (*sacer*)	ad. ♀	20⅜	17—
Clara Island (*pulcher*)	ad. ♀	19⅛	18⅛

This table shows close agreement in size between specimens from different islands; but it supports the conclusion that collectively they are a little smaller than the mainland form *ravus*, although the difference between the adult ♀ (*pallens*) from Kisseraing Island and the adult ♀ (*ravus*) from Tenasserim Town is negligible.

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In the following table are given some skull measurements recorded by Miller in mm. converted into English inches, for comparison with those used in my tables above.

Locality and Sex	Cond. bas. length.	Zygom. width.	Int. orb. width.	Max. width.
Domel Island (*senex*) yg. ad. ♂	3·9	2·3+	·7	·8
James Island (*fuscus*) ad. ♀	4·0	2·1	·6½+	·7
Kisseraing Island (*pallens*) ad. ♀.	4·1	2·3	·7¼	·8--
Sullivan Island (*pugnax*) ad. ♀	3·9+	2·2½	·7	·7½
St. Matthews Island (*sacer*) ad. ♀	3·9+	2·2½	·7	·7½
,, ,, ,, ad. ♂	4·0	2·4—	·7	·7½
Clara Island (*pulcher*) ad. ♀	4·0	2·2½—	·6¾	·7½
,, ,, ,, ad. ♂	4·1—	2·4+	·6¾	·8

Collectively these skulls are smaller than those of *ravus*; but there is not much to choose between them and the skulls of the Tenasserim specimen of *minor*. So far as the measurements themselves are concerned, they fall within the limits of individual variation in mainland races.

Genus: Paguma, Grey.

Paguma, Gray, *Proc. Zool. Soc.*, 1831, p. 94; and of all recent authors.

Paradoxurus, Blanford (in part).

Type of genus: *larvata* Gray, from S. China.

Distribution: from S. China westwards to Tibet and Kashmir, and southwards to Sumatra and Borneo.

The external differences between this genus and *Paradoxurus* are comparatively unimportant. *Paguma* never shows a trace of pattern of spots and stripes, there is a median pale band on the face extending from the rhinarium to the crown and, so far as my experience goes, there are always two pairs of mammæ, instead of three pairs which seem to be invariable in *Paradoxurus*. The essential differences between them in the skulls are given above and need not be repeated.

Setting aside the Tibetan species described by Hodgson as *Paradoxurus lanigerus*, of which the skull is unknown, most authors have assigned three species to *Paguma*, namely: *grayi* from the Himalayas, a medium-sized form with an obscurely

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defined 'mask' or facial pattern, a long luxuriant winter coat, and dark, buffy-grey in tint from the crown to the rump; *larvata* from China, a smaller form also with a long, thick winter coat, but more richly tinted on the body with the nape and part of the shoulders black and a very pronounced black and white 'mask'; and *leucomystax* from Malacca, Sumatra and Borneo, the largest of the three, with a shorter, thinner coat, darker brownish hue and obscurely defined mask. These were the earliest described species, and widely sundered geographically; but specimens subsequently collected in Burma, Indo-China, Siam and the northern part of the Malay Peninsula show intergradation in all the supposedly specific characters,—size, coat, colour and the pattern of the mask. Hence I have no hesitation in accepting the conclusion of Robinson and Kloss that the three original names indicate extreme racial forms of but one species, which must take the oldest name, *larvata*.

I admit two species of *Paguma* which may be distinguished as follows:—

a. Tail short, only about half the length of the head and body ... ... *lanigera*.

a^1. Tail long, nearly, sometimes quite as long as the head and body ... ... *larvata*.

Paguma lanigera, Hodgson.

Paradoxurus lanigerus, Hodgson, *Asiat. Res.*, xix, p. 79, 1836.

Paradoxurus laniger, Hodgson, *Journ. As. Soc. Bengal*, x, p. 909, 1841; *id. op. cit.*, xi, p. 279, 1842; also of Gray and Blanford as *Paradoxurus* or *Paguma*.

Paguma grayi, Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xx, p. 50, 1918 (not *grayi*, Bennett).

Locality of type: An only known specimen, originally said to be 'the northern region of Nepal', but in 1842 said to be Tingree in Tibet.

Although the skull of this species is unknown, I adopt without hesitation the view that it belongs to *Paguma* because of its distribution and the absence of all trace of pattern on the body combined with the forward growth of the hair on the nape. It differs from all the other species of *Paguma* and all the species of *Paradoxurus* in the shortness of the tail which is only about half the length of the head and body. This feature was ignored by Wroughton when he cited *lanigera* as a synonym of *grayi*.

The following is a description of the type and only known specimen preserved in the Natural History Museum (No. 43.1.12.103):—

Dorsal coat from the crown backwards very thick, woolly and matted, about 40 mm. long, the wool copiously mixed with fine, whitish hairs with their curled, frizzled ends hardly projecting beyond the summit of the wool; hairs of the face, paws, throat and belly sleek and comparatively short, general colour pale brown, darker and more rufous on the back than on the flanks; legs and upper side of tail like the back; ventral surface mostly creamy

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white from the throat backwards. No black tipped or annulated hairs and no trace of pattern; the superciliary vibrissae buffy grey; genal vibrissae white; mystacial vibrissae not preserved. Hair reversed in growth along the nape and on the crown between the ears. Tail woolly like the body, thick at the base whence it gradually tapers to the point, only about half as long as the head and body. Soles of the feet and pads apparently quite normal in their hairy clothing. Head and body about 20 inches, tail 9½ inches; the tail is apparently perfect but Hodgson gave its length as 12 inches.[1]

From the condition of the coat of this skin I have no doubt that the moult was imminent. The new coat, it is likely enough, would be very differently coloured, possibly provided with black or partially black hairs, which were already moulted or had lost their black tips at the time of death. The thickness of the basal part of the tail suggests an accumulation of fat for sustenance in the winter months during which the animal perhaps hibernated.

Paguma larvata, Gray.

The principal bibliographical references to the British Indian representatives of this species are quoted below under the various subspecific headings. It may be distinguished from *lanigera*, the only other species of the genus, here admitted, by the length of the tail as stated above. Its distribution is from Southern China westward through the Himalayas to Kashmir and southwards to Sumatra and Borneo.

The following is a key to the British Indian races:—

a. Hairs of preaural fringe at most projecting forwards a comparatively short distance over the cheek to form with their tips a crest some distance behind the eye.
  b. Pattern of mask emphatically black and white, the median band separated from the pale areas between the eye and ear and continued over the nape to the withers or beyond ... ... *intrudens*.
  *b*¹. Pattern of mask less emphasised, the median band confluent on the forehead with the pale areas between the eye and ear and not continued as a definite stripe beyond the forepart of the nape.
    c. Size large, coat longer and thicker, pattern of mask more distinct, its pale areas lighter than the general tint of the back.
      d. Nape black, with the pale median area of the crown sharply contrasted with it, size larger. *wroughtoni*.
      *d*¹. Nape typically copiously speckled with grey like the back and not sharply contrasted with the crown of the head.
        e. Winter coat much longer and thicker ... *grayi*.
        *e*¹. Winter coat shorter and thinner ... *neglecta*.
    *c*¹. Size small coat shorter and thinner, pattern of mask obscure, its pale areas the same tint as that of the back ... ... *tytleri*.

[1] Hodgson may have had more than one specimen. In his unpublished drawings he gives three illustrations of the species and one of them is more richly coloured than the others.

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a^1. Hairs of preaural fringe projecting so far forwards as to form a crest close to the eye, defining a large whitish area on the cheek.
f. General colour tawny, nape at most pale brown ... ... *robusta*.
f^1. Colour much darker, nape deep blackish brown ... ... *janetta*.

The primary distinctive features used in this table are those of the three forms, formerly regarded as distinct species, namely *larvata*, *grayi* and *leucomystax*. The characters cited in paragraph *b*, eliminating *intrudens*, are true of most but not all, examples of typical *larvata*, the southern Chinese race. Those cited in paragraph b^1 under which are comprised *wroughtoni*, *grayi*, *neglecta* and *tytlerii*, apply to *grayi* as understood by Blanford. Finally, those cited under a^1 comprising *robusta* and *janetta*, apply to most specimens formerly regarded as *leucomystax*.

PAGUMA LARVATA WROUGHTONI, Schwarz.

Paradoxurus grayi, Blanford, *Mamm. Brit. Ind.*, p. 112, 1888 (in part).

Paguma grayi wroughtoni, Schwarz, *Ann. Mag. Nat. Hist.* (8), xii, p. 289, 1913; Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xx, p. 51, 1918.

Locality of type: Gharial near Murree in the Upper Punjab.

Distribution: Kashmir and the Upper Punjab.

Distinguished from the earlier described Himalayan race, *grayi*, and approaching the Chinese race *larvata*, chiefly by the generally black hue of the nape and fore portion of the shoulders, resulting from the partial or complete suppression of pale speckling in the hairs of those areas; by the more sharply contrasted facial pattern and by the extension of the pale hairs of the crown to form a short median, whitish streak set off by the blackness of the nape. The winter coat also appears to be longer, looser, with less luxuriant underwool than in *grayi*. The two races, however, completely intergrade.

The type of *wroughtoni* is the undated, unmeasured skin of an old ♂ from Gharial, near Murree in the Upper Punjab (Major H. N. Dunn, B.M. No. 7.11.21.11). The coat is long, about 46 mm. and loose with comparatively short and thin underwool. The general colour of the back is dark greyish due to an intimate mixture of black and pale speckling in the hairs of the upper side, the pale speckling buffy grey on the hind back, clearer on the fore back and reduced by the extension of the black to a nearly negligible amount on the nape and fore part of the shoulders. Tail gradually darkening in its distal half. The under side whitish. The 'mask' is strongly emphasized; the sides of the muzzle and area round the eyes brown; the middle line of the nose and forehead greyish white, the crown between the ears and the greater part of the cheek, owing to the large size and confluence of the patches above and below the eyes and the preaural fringe, grey; but behind the crown on the occiput the median pale band forms a conspicuous whitish streak set off by the black hairs on each side of it.

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A young adult ♀ with the same history, but dated June 13, is very similar to the ♂ but has the coat a little longer, about 50 mm., and the cheeks browner owing to the isolation of the subocular spot.

A skin, without skull or further particulars but ticketed Sopir (Sopur, 65 miles N.E. of Murree, near Lake Wular), Kashmir, is of interest as being the most northern representative of the species yet recorded. It has the same loose, long coat, 52 mm., as the Gharial specimen and closely resembles the type.

At Chamba, H. W. Wells procured two examples for the Survey. A young ♂ from Deolah, 6,000 ft., January 5, has the coat long and loose, about 54 mm., as in the other specimens, although the underwool is considerably longer; the nape is black and the face, apart from the sides of the muzzle mostly grey. The other example from Pangi, 9,000 ft., is a flat skin with no measurements, dated December 23rd, but this is no doubt the date of the donation of the skin to Wells, not of its capture, because the coat is only 40 mm. and appears to be new. The face is dominantly grey, as in the one from Deolah, the nape is black with minute buff speckling and the back has abundance of black speckling. At Dharmsala, 5,000 ft., Mr. H. Whistler, secured a half grown ♀ (No. 25.10.2.5), dated June 21, which also has the face dominantly grey, the sides of the muzzle, a ring round the eye and a short stripe above it alone being brown; the nape and shoulders are dusky black, with no pale speckling and the coat is tolerably full, soft and about 40 mm. long.

An adult from Simla (*A. O. Hume*), referred by Blanford to *grayi*, has a thin, loose, long coat about 150 mm. as in the examples from Gharial and Sopur which it generally resembles in colour, but the narrow white band on the crown is continued backwards on to the nape and the pale areas of the mask are duller, not so whitish grey, and the patches above and below the eye, although large, are separated from each other and form the grey of the preaural fringe. In its less conspicuous mask pattern this specimen is transitional to *grayi*.

The available material of this race is unfortunately scanty. All the adult or subadult skins are undated and unmeasured, but in all the coat is long and loose, at least as long as in the best skins of *grayi* but with shorter, less luxuriant underwool. And this applies to the only reliably dated skin, that of the immature ♂ with milk-teeth, collected at Chamba on January 5th, when the coat should be nearly at its best. The only known skulls, however, those of the type and topotype are a little longer than skulls of *grayi* from Nepal. Hence the inference that *wroughtoni* is typically rather larger than *grayi*.

Paguma larvata grayi, Bennett.

Paradoxurus grayi, Bennett, *Proc. Zool. Soc.* 1835, p. 118; Blanford, *Proc. Zool. Soc.* 1885, p. 803; and *Mamm. Brit. Ind.*, p. 112, 1888 (in part).

Paguma grayi, Gray, *List Mamm. Brit. Mus.*, p. 54, 1843;

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id. Proc. Zool. Soc. 1864, p. 541; and of most subsequent authors (at least in part).

Paradoxurus nipalensis, Hodgson, *Asiat. Res.*, xix, p. 76, 1836.

Locality of type of *grayi*: 'India'.

Locality of type of *nipalensis*: Nepal, mainly the hilly region (Hodgson).

A little smaller than *wroughtoni*, judging from the size of the skull, and with the underwool of the winter coat longer and more luxuriant so far as the available skins indicate. Also in the traditionally typical form from Nepal further distinguished by the profuse pale speckling on the hairs of the nape and fore shoulders, which, instead of being blackish and contrasted with the back and loins as in *wroughtoni*, are nearly the same general hue; and by the duller, less silvery grey tint of the pale facial pattern. This last feature may, however, be due to soiling in the Nepal skins, which have been nearly a century in the Museum; and in some skins from Kumaon the nape is almost as black as in the typical form of *wroughtoni* from Murree and Kashmir.

The type of this race (B.M. No. 55.12.24. 232), ticketed 'India' Zool. Soc., was, judging from its skull, a menagerie-reared specimen, and since the abdomen is creamy white I sex it as a female. Since, moreover, it resembles one of Hodgson's Nepal specimens more closely than it resembles any other skin from 'India' I have seen, I accept the traditional identification of Hodgson's specimens as *grayi*. The coat is full and soft, the long hairs being about 38 mm. and the wool about 24 mm., thus agreeing very closely with Hodgson's description of the coat of *nipalensis* which he said was 1½ inches long (=40 mm.) with the wool 1 inch (=25 mm.). But the general tint of the hind-back, rump and tail is more buffy than in most of Hodgson's specimens, many of the hairs being not perceptibly dark at the tip, and the tail, complete or nearly so, is tolerably uniformly buffy throughout. On the fore-back, shoulders and nape the pale speckling in the hairs becomes gradually greyer and the black speckling more evident. The pattern of the face is fairly well defined, the greyish buff fronto-nasal band, paler on the forehead, being defined above by a streak running up from the corner of the eye, separating it from the greyish superciliary patch which nearly blends with the grey hue of the preaural fringe; the subocular patch is large but indistinctly defined posteriorly.

Specimens from Nepal: In the British Museum there are six skins, ticketed 'Nepal', which on account of their thick coats I judge to be early or late winter skins. All are without measurements and unsexed, but most of them I have sexed by the glandular area. Three belong to Hodgson's collection. A ♀ (No. 43.1.12.118) very closely matches the type of *grayi*, but is not quite so buffy and is more distinctly dark speckled on the hind back and tail, the tail being all dark in its distal half. The coat is thick with underwool and about 40 mm. long. A second ♀ (No. 45.1.8.296) has greyer speckling than the last, almost silvery grey on the fore quarters, the coat is 43 mm. long and equally thick.

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A young, unsexable flat skin is speckled grey and black, the coat being 46 mm. long. Two adult ♂ skins (Mrs. Warren, Nos. 167 *a* and *b*) are tolerably uniformly speckled buffish grey and brown above, with the belly grey, not creamy white. In one the coat is 41 mm., in the other 47 mm., the wool being respectively 21 and 25 mm. A subadult ♂ (Dhuleep Singh, No. 55.1.20.10) has abundance of black speckling on the back, with the belly grey, and a very luxuriant coat, the long hairs 50 mm. and the wool about 35 mm. Another ♂ (Wormald, No. 88.10.25.1) ticketed 'Himalayas', is very like the last but rather more richly buff tinted posteriorly. The long hairs of the coat are also about 50 mm. and the wool about 31 mm. These two specimens approach *wroughtoni* in the black pigmentation of the neck; but have the pattern of the mask comparatively dull as in all the Nepal specimens previously referred to. Otherwise the mask is variable, resembling that of the type in some, but in others the pale areas encroach over the forehead and cheek which are dull, but rich grey, only the sides of the muzzle and the lower cheek being brown.

From the above given description it will be seen that the coat varies in length from about 40 mm. to about 50 mm., the latter, as exemplified in Dhuleep Singh's skin, representing, I assume, the complete winter coat of February and March. But four additional skins in Hodgson's collection have comparatively short coats with scanty underwool and these on the average are darker tinted than the longer coated forms. Blanford took them for a lowland variety of *grayi;* but since several of them are obviously moulting, I have no doubt they are 'summer' skins. One of them, apparently ♂ (No. 45.1.8.297) was chosen by Thomas as the type of *nipalensis*. But the choice was not very happy, since the coat is short and thin, not agreeing with Hodgson's description. The pale speckling is richer buff than in the thick coated skins. The remaining three are ♀ skins with two pairs only of large teats indicating the suckling of young. One (No. 58.6.24.57) is a poor, shabby skin in moult, very like the skin selected as the type of *nipalensis*, but tolerably uniformly speckled with ochreous above. Another (No. 58.6.24.58) is in moult like the last, but is a darker specimen, with a good deal of blackish brown ochreous speckling on the back. The third (No. 58.6.24.40) is also moulting, with the new coat erupting on the neck and shoulders. It may be described as a 'rufescent' variety, the whole dorsal surface being richly speckled with rusty ochreous, with the belly rich ochreous buff, especially round the gland, on the back of the thighs and on the root of the tail; even the pale areas of the mask are tinted with buff. In none of these short-coated specimens is the pattern of the mask strongly contrasted.

Specimen from Kumaon: Skins from this state resemble those from Nepal, identified as *grayi*, in the size of the skull and the length and luxuriance of the underwool of the winter coat, but some of them have the nape as black as in *wroughtoni*, and in this respect are annectant forms. Two ♂ examples collected for the Survey by Crump at Dhakuri, 9,000 ft., on September 19th. and

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21st. are of special interest. The coat is long and thick, as good as in the best skins assigned to *grayi*, although judging from the time of the year it had not attained full growth. It is much fuller and closer than in the skin from Deolah, Chamba, January 5th. They are darkish skins with abundance of black speckling in the pelage; one is about as black on the nape as in *wroughtoni*, although this area is not so strongly contrasted with the back; the other is not so black on the nape and has the pale speckling on the body more ochreous than the first.

A skin from Swarkot, 3,569 ft. (*C. A. Crump*), August 21st., is moulting, with most of the long hairs gone; the nape is blackish as in *wroughtoni*. Two from Naini Tal (E. A. Smithies), on the contrary, have the neck gray as in *grayi*; in one the coat is long and loose as in *wroughtoni*, in the other it is thin and short, only about 25 mm. long. The skin of an old, but suckling ♀ collected by Col. C. H. Stockley on July 3rd in Eastern Kumaon, also has the neck grey; the coat is thin, short and in moult and the belly is cream or pale buff, as is commonly the case in suckling females.

Skull measurements of *wroughtoni* and *grayi*.

	In English Inches.					In Millimetres.		
Locality and Sex	Total length	Zygom width	Waist width	Int. orb. width	Max width	Bulla	Pm^4	M^1
wroughtoni								
Murree, Upper Punjab (type) old ♂ ...	5·0	2·8½	·9½	1·0	·9½	16–17	8×6	6×7
,, ,, yg. ad. ♀	4·7¼	2·5½	·8	·9–	·9	19–	9×6	6×7
grayi								
Dhakuri, Kumaon ad. ♂	4·6	2·6	·9	·9+	·9+	17	8×6½	6×6½
,, ,, yg. ad. ♂	4·5½	2·3½	·8½	·8	·8	17	7×6	6×7
E. Kumaon (Stockley) old ♀	4·7½	2·5½	·8	·9	·9	18	–	–
Naini Tal ... ad. ♀	4·6½	2·4	·9	·8+	·8½	17	8×5½	6×7
'India' (type) yg. ad. ♀	4·5½	2·3½	·9	·9	·9	18	7×6	6×7
Nepal (58.6.24.40) ad. ♀	4·7	2·7½	·8	·9+	·9+	19	9×6	7×8
Nepal (43.1.12.118) ad. ♀	4·4½	2·6	·9	·9	·8½	16½	7½×5½	6×7
,, (45.1.8.296) ad. ♀	...	2·4	9·	·8½	·8½	18	8×5½	7×7½

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This table shows the slight superiority in size of the skulls of *wroughtoni* over those of *grayi*. The skull of the ♂ (type) of *wroughtoni* is old, even most of the facial sutures being obliterated and the teeth a good deal worn; but, despite its age the temporal ridges merely meet without forming a definite sagittal crest. The bullae vary in size, both being smaller than those of the smaller and younger ♀ skull, which has the basi-occipital suture still unfused and the temporal ridges 9 mm. apart on the parietals. This skull is a trifle longer than the largest of the ♀ skulls of typical *grayi* from Nepal, although considerably younger, and closely resembles in all its dimensions the old skull from E. Kumaon (Stockley), which has the teeth too worn for useful measurement. This skull also has no sagittal crest, the ridges not quite meeting on the crown, being 4 mm. apart at their widest. In the first adult ♀ from Naini Tal they are 9 mm. apart. The only skull of this series, indeed, which has a distinct, though low, crest is the oldish ♀ skull from Nepal (58. 6. 24. 40), belonging to the short-coated rufescent skin above described. It is on account of the general agreement in size between the skulls from Kumaon and Nepal that the former are assigned to *grayi*, although the skins of the specimens from Dhakuri as well as the one from Swarkot, might be taken for *wroughtoni* from the blackness of the nape.

Paguma larvata neglecta sub-sp. nov.

Paradoxurus grayi, Blanford and *Paguma grayi*, Wroughton (in part).

Locality of type: Mokokchung, Naga Hills, Assam.

Distribution: Assam thence southwards to the Chin Hills and Arakan in Burma, and apparently westwards to Darjiling and the low lying districts of Nepal.

Resembling typical *grayi* of the hilly districts of Nepal in the uniformly coloured dorsal surface from the crown to the tail, but differing in its noticeably shorter and less luxuriant winter coat. The proximal portion of the tail is also on the average more brightly ochreous in examples from the districts to the east of the Brahmaputra.

The type, a subadult ♂, unmeasured, from Mokokchung in Naga Hills, 4,500 ft. (*H. W. Wells*, B.M. No. 21.8.2.7), collected in April, before the early summer moult, has the coat about 38 mm. long and moderately thick with underwool. The dorsal surface from the crown of the head to the root of the tail is well coloured with black and buff speckling, the buff being richer on the hind body and rump than anteriorly. The tail is rich ochreous buff proximally, the hairs mostly without black tips, paler buff with black tips distally, the terminal two inches black. The legs are externally grizzled and the underside is whitish from the black chin to the anus. The mask is well defined, dark brown and

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mostly clear silvery grey; the naso-frontal band, speckled black and white on the forehead and over the eyes, passes over the crown to blend with the buffy grey of the nape and between the eye and the ear it is confluent with the speckled superciliary patch

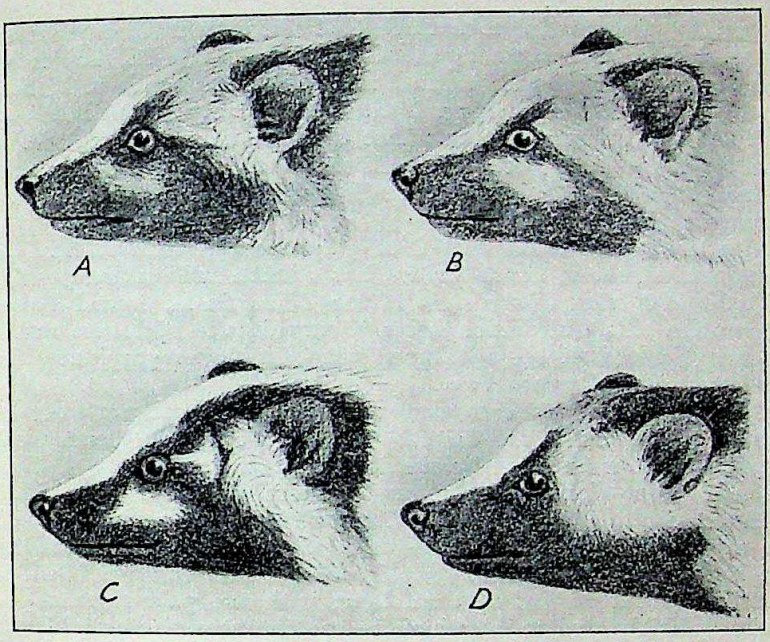

Fig. 6.—*A*. Head of *Paguma larvatus wroughtoni* from the Upper Punjab. *B*. Head of *P. l. neglecta* from the Naga Hills. *C*. Head of *P. l. intrudens* from Myitkyina, Upper Burma. *D*. Head of *P. l. janetta* from Tenasserim.

which itself blends with the whitish of the preaural fringe, so that there is a continuous well-defined pale band running across the forehead, in front of the ears on to the throat, the subocular patch is large and conspicuous on the dark brown of the cheek.

A ♂ from Duragiri in the Garo Hills 3,000 ft. (*H. W. Wells*), March 21st., has the coat almost as in the type but a little shorter, about 35 mm long. The general colour is not so rich, the pale speckling being greyer, less buff, and the black and grey speckling everywhere finer; the tail also is not so bright. The pattern of the mask is not so contrasted, the forehead and superciliary patch being more grizzled and this patch is separated from the frontal band by the upward extension of the stripe above the eye to join the circumaural brown area, but is broadly confluent with the white of the preaural fringe and collar behind the cheek; the subocular patch is smaller and less conspicuous.

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A flat, unmeasured skin from Dening in the Mishmi Hills in N.E. Assam, 2,250 ft. (H. W. Wells), April 22nd. has the coat thickish but short, about 31 mm. The general coloration is very much as in the type from the Naga Hills but the mask is not so white, more as in the Garo Hill specimen, but the tail is rich ochreous proximally.

I also refer to this race three badly preserved skins procured by J. M. D. Mackenzie in the Chin Hills, 4,000 ft., 150 miles west of Kindat in Upper Burma, some 200 miles south of Mokokchung. They are dated April 22nd., but this only signifies the day of their receipt from natives. Two of them are richly tinted like the type one with noticeably ochreous tail, and have the coat 34 and 38 mm. long; the third has longer hair, about 40 mm., and is greyer as if bleached.

No doubt Blanford's record of *grayi* from Arakan referred to this race, which, so far as known, has a north and south extension of some 500 miles to the west of the Chindwin River and Lower Irrawaddy. Its distribution helps to explain the otherwise rather puzzling general likeness between the Himalayan *grayi* and the Andaman Island race *tytleri*.

Evidence for the extension of this race north-west of the Brahmaputra, even into Nepal, where doubtless it blends with typical *grayi*, is supplied by the following skins:—

Two from comparatively low altitudes in the Nepal Valley collected for the Survey by N. A. Baptista, a young adult ♂ with no skull, at Thankot on May 14th., and an adult ♀ at Hathibau on May 25th. The coat is not luxuriant with underwool and is shortish, about 36 and 38 mm. long, with the pale areas of the hairs, possibly due to bleaching before the moult, clearer, more silvery grey than in the Nepalese skins identified as *grayi*, and the pattern of the mask more sharply defined, the dark areas being blacker and the pale areas whiter grey, as in the type of *neglecta* from the Naga Hills, but the pale speckling is greyer, not so buff and the proximal portion of the tail is not richly tinted.

There are also two skins from Darjiling. One an adult ♂ collected for the Survey by Crump at Narbong, 2,000 ft., on March 9th. The coat, which from the date should be at its best, is only 35 mm. long and not nearly so thick as in the long and thick coated examples of *grayi* from Nepal and Kumaon. The general colour is considerably darker than in the type and in Baptista's specimens, owing to the fine pale speckling of the long hairs, which is mostly silvery grey with a buffish wash on the middle line of the back. It more resembles the example from the Garo Hills; but the facial pattern is more strongly contrasted as in Baptista's specimens. The second from the Gopaldhana Valley (H. Stevens, No. 19. 7. 26. 5), January 12th., is not definitely assignable either to *grayi* or *neglecta*, but may be regarded as an annectant type. The general coloration is much as in *grayi* and the winter coat is about as long, but it is softer and has much thinner underwool than the best coated skins of *grayi*

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from Nepal and Kumaon. In neither of these Darjiling specimens is the tail noticeably ochreous proximally.

The following are the only available flesh measurements, in English inches, and weights of specimens, referred to the three races, *wroughtoni*, *grayi* and *neglecta*, described above. To these is added the length of the coat in millimetres.

In English Inches.

Locality, Date and Sex	Head and Body	Tail	Hind foot	Weight	Coat in mm.
wroughtoni.					
Deolah, Chamba, 6,000 ft. Jan. 5. immat. ♂	19⅜	20	3	...	54
grayi.					
Dhakuri, Kumaon, 9,000 ft. Sept. 21. ad. ♂	25⅜	24⅕	4+	11½ lbs.	51
Do. Sept. 19 ; yg. ad. ♂	23⅜	22½	4–	8¼ ,,	53
neglecta.					
Hathiban, Nepal, May 25th. ad. ♀	24⅘	24⅘	3⅘	11 lbs.	36
Thankot, Nepal, May 14th. yg. ad. ♂	23⅕	23⅜	4⅛	...	38
Narbong, Darjiling, March 9. ad. ♂	25⅘	23⅗	4⅛	9½ lbs.	35
Duragiri, Garo Hills, March 21. ? ad. ♂	24⅘	24	3⅘	5½ ,,	34

In the measurements of the head and body, tail and hind foot there is little to choose between the specimens; but the table brings out clearly the difference in the length of the winter coat between the western specimens from Chamba and Kumaon and the eastern from Darjiling and the Garo Hills. In reality the difference is probably greater than the figures indicate. The example of *wroughtoni* from Chamba is a male with milk teeth, killed in January. One would expect the coat of the adult in March to be still longer, also it is safe to claim that the September coat of the specimen from Kumaon would have been considerably longer by March. On the other hand, in the specimens from Darjiling and

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the Garo Hills, killed in March, the coat may be regarded as having reached its full growth. The coat of the examples from Hathiban and Thankot in Nepal, killed in May, is more doubtful. In both the underwool is thin from the moult; but the long hairs seem to be those of the winter coat bleached grey. In that case they resemble in length those of *neglecta*.

Paguma larvata tytlerii, Tytler.

Paradoxurus tytlerii, Tytler, *Journ. As. Soc. Bengal* 33, p. 188, 1864; Blanford; *Proc. Zool. Soc.* 1885, p. 805, and *Mamm. Brit. India*, p. 113, 1888 (referred to *Paradoxurus grayii*), Miller, *Proc. U.S. Nat. Mus.* 24, p. 772, 1902.

Locality of type: Port Blair; S. Andaman Island.
Distribution: Andaman Islands.

A shorter coated race than the northern mainland forms, also smaller judging from the skull and the recorded body measurements, and pale tinted, the dorsal pelage speckled grey and black, and tolerably uniformly from the crown to near the end of the tail; The 'mask' but little differentiated, its pale areas grey, like the nape and back, and the dark areas pale brown.

There are three skins of this race in the British Museum; a female unmeasured and without skull, from Rutland Island (C. G. Rogers 6.9.1.3), April 4th., has a short thin coat, 18 mm. long, the colour of the upper side is tolerably uniformly dark grey, due to a mixture of black and grey speckling, and the under side white; the tail is mostly the colour of the back, but becomes blackish grey in its terminal third; the 'mask' is indistinct, grey and brown, grey, matching the body, on the preaural fringe, the superciliary patch, the forehead and the midline of the nose, brown on the sides of the muzzle and the lower cheeks.

A young ♂, with skull but unmeasured and merely ticketed Andamans (A. O. Hume; No. 85.8.1.30), has a longer coat, 26 mm. with more underwool than the last and is rather better tinted owing to the black and grey areas of the hairs being more extensive, and the tail is not appreciably darkened at the end.

The third skin belonging to the mounted specimen mentioned by Blanford is dull coloured, probably faded, and in moult.

Miller's specimen, like the type, came from S. Andaman Island. It was an adult ♂ measuring: head and body 22 in., tail 19⅕ in., hind foot 3⅛ in. The type, according to Tytler, was very nearly the same, namely head and body 21 in., tail 20 in., but whether adult or not is unknown. Miller did not describe his specimen apart from the record of its dimensions in the flesh and of the skull.

There are two skulls in the British Museum of which the dimensions are as below, together with the corresponding dimensions, where available, of Miller's specimen.

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Skull measurements of *neglecta* and *tytlerii*.

Locality and Sex	In English. Total length	Zygom. width	Waist width	Int. orb. width	Max. width	In Millimetres. Bulla	Pm^4	M^1
neglecta.								
Hathiban, Nepal. ad. ♀	4·6	2·5	·8+	·8½	·9–	18	9– ×6	7 ×8
Narbong, Darjiling. oldish ♂	4·8	2·7	·9	·9	·9	19	8½ ×7	7 ×8
Naga Hills, Assam (type). yg. ad. ♂	4·9–	2·7½	·9	·9	·9+	...	8½ ×6	7 ×8
Chin Hills, Burma oldish (?) ♂	4·8½	2·8½	·9	·9	·9½	...	9 ×7½	7 ×8
tytlerii.								
Andamans. old (?)♂	4·4	2·7	·7	·8	·8+	17	7 ×6	6½ ×8
Andamans. young ♂	4·3½	...	·8	·8	·8	...	8 ×5½	6 ×7
S. Island, Andamans (Miller) ad. ♂	4·2½	2 4	...	·8½	...	...	...	...

With regard to the skulls assigned to *neglecta* it is noticeable that the ad. ♀ skull from Hathiban has no sagittal crest, the temporal ridges being 9 mm. apart and that in the oldish male skull from Narbong they are 5 mm. apart; thus agreeing with the skulls of *grayi* and *wroughtoni*, which seem rarely to develop the crest. In both the ♂ skulls from the east of the Brahmaputra, on the contrary, there is a definite sharp sagittal crest, even in the type-skull from the Naga Hills, which is not quite fully developed.

The two skulls of *tytlerii* in the British Museum are a little but not very much smaller than those of the other races.

The first on the list (Zool. Soc. No. 70.12.17.1) is unsexed and was extracted from the mounted specimen referred to by Blanford. It is old, with worn teeth, and even the facial sutures obliterated; the sagittal crest is 3 mm. high, the post-orbital area, or 'waist' unusually narrow, and the post-orbital processes long. These features combine to make it more like the skull of *Paradoxurus* than any skull of *Paguma* I have seen. But it cannot be regarded as

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typical of *tytleri* because, coming from the Zoological Society, it is probably a menagerie-reared skull. The second, belonging to Hume's specimen, is young, with all the milk teeth in place, but the first molar is through the bone and the permanent canines are showing. For measurement the 4th upper premolar of the permanent set was cut out of the maxilla. It will be noticed that this skull, despite its immaturity, is longer than that of the adult topotypical ♂ from South Island, recorded by Miller.

Paguma larvata intrudens.

Paguma larvata intrudens, Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xix, p. 793, 1910; id. op. cit., xx, p. 51, 1918; Thomas, *Ann. Mag. Nat. Hist.* (9), viii, p. 617, 1921; G. M. Allen, *Amer. Mus. Novit.*, No. 359, p. 7, 1929.

Paguma larvata vagans, Kloss., *Journ. Nat. Hist. Soc., Siam*, iii, p. 73, 1919.

Paguma larvata yunalis, Thomas, *Ann. Mag. Nat. Hist.* (9), viii, p. 617, 1921.

Locality of type of intrudens: Sima in Myitkyina, Upper Burma.
,, ,, ,, *vagans*; Sikawtur, N.-W. of Raheng, W. Siam.
,, ,, ,,*yunalis;* Yenguensien in S. Szechwan.

Distribution: From S. Szechwan, Yunnan and N.-E. Burma to Laos, Tonkin, the Shan States and Siam.

Note on the synonymy: Wroughton distinguished the Burmese specimens he named *intrudens* from a series of specimens from S. Szechwan and Yunnan, which he identified as typical *larvata*, by the extension of the white crest over and beyond the withers and by their generally paler tint. Accepting this difference Thomas subsequently named the Szechwan and Yunnan specimens *yunalis*, separating this race from *larvata* by its better colour. But G. M. Allen, who had a fine series of typical *larvata* from S. China and several skins from the districts whence *yunalis* was recorded, showed that the characters relied on by Wroughton and Thomas have not the value assigned to them. He therefore united *yunalis* with *intrudens*, pointing out that the specimens to which these names were given represent a race differing from typical *larvata* merely by its slightly superior size. My examination of the skins and skulls seen by Wroughton and Thomas confirms Allen's conclusion. My reason for adding *vagans* to the synonymy is given below.

Description: Distinguished from the Himalayan and Andamanese races, hitherto considered, by the more sharply contrasted black and white pattern of the 'mask', combined with the extension of the median white area of the crown along the nape to the withers, or beyond, and its conspicuousness owing to the blackness of those areas. Resembling in those respects typical *larvata* of southern China; but a little larger.

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There are three Burmese examples of this race in the British Museum. A young adult ♀ (type) from Sima in Myitkyina, 4,500 ft., near the western border of Yunnan (A. W. Kemmis, No. 9.7.20.6), November 9th. General colour of the dorsal surface and flanks dull buff, speckled with black, the black more in evidence on the shoulders than behind them; neck still blacker but with a broad white median band continuous in front with the band on the crown and passing on to the withers where it is interrupted, but re-appears for a few inches behind them. Lower surface mostly white, the hairs grey at the base; more grey on the chest, throat white behind, black, like the chin, in front. Tail like the back in its proximal portion; distally black. Mask, as above described, with a broad median white band from the top of the muzzle over the crown, a large subocular white patch; superciliary patch also tolerably large and only narrowly separated from the preaural fringe, the white of which is broadly continuous below the ear with the white throat-collar; the rest of the face jet black, emphasising the white.

Two examples from Pyaunggaung in the North Shan States, 2,794 ft. (*G. C. Shortridge*, No. 14.7.8.61 and 62). An immature ♀, May 11th, is practically identical with the last, with the coat a little longer but thinning from the moult. An adult ♂, April 30th, also has the coat thinner than in the type owing to the moult, most of the long hairs being shed on the neck. The general colour is a richer, more golden buff than in the others, with less black speckling because most of the hairs have no black tips, a feature common in Chinese specimens, although small black tips are present on the shoulders. The white median stripe on the nape owing to the shortness of the hairs is much narrower and does not reach the withers; the mask is very similar but the superciliary patch is confluent with the white of the preaural fringe. The tail is grey, except at the base, and the legs are brown, speckled with grey, with black toes, not mainly black as in the two females.

The variations between these skins of *intrudens* have an important bearing on the status of the supposed race *vagans* based upon a single female without the skull, said to differ from *intrudens* by the tips of the hairs being black instead of buff, the white nape stripe not extending on to the withers, the superciliary and preaural white patches confluent, the under side cream and the hind legs ochreous on the inner side. But in the type of *intrudens* the hairs are black tipped; in the ♂ from the N. Shan States the nape stripe falls short of withers, and the two white areas on the head are confluent; in both the females of *intrudens* there is some ochreous on the inner side of the hind legs and the colour of the belly is known to vary individually from white or grey to cream in races of *Paguma*, cream, as above pointed out, being common in females.

In the following table are entered the dimensions, in English inches, and the weight, of the only examples of *intrudens* in the British Museum, measured in the flesh, and those of the type of

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vagans recorded by Kloss. To these have been added the length of the coat in millimetres.

Locality, Date and Sex	In English Inches. Head and Body	Tail	Hind Foot	Weight	Coat in mm.
N. Shan States; April 30; yg. ad. ♂	27⅛	24⅜	4½	11 lbs.	37
N. Shan States; April 30; immat. ♀	22⅜	21⅛	4⅛	6½ ,,	48
Myitkyina (type of *intrudens*) Nov. 9; yg. ad. ♀	24	23	3⅜	...	41
Hills N. W. of Tengyueh, Yunnan; Aug. ad. ♀	26⅛	24⅛	4	...	45
Nape, Laos. Jan. ad. ♀	25	23¼	3¾	...	...
N.W. of Raheng, Siam (type of *vagans*) ? ad. ♀	24⅛	23	3	...	...

Measurements of the three available skulls of Burmese examples of *intrudens*. The second on the list carries complete milk dentition.

Locality and Sex	In English Inches. Total length	Zygom. width	Waist width	Int. orb. width	Max. width	In Millimetres. Bulla	Pm^4	M^1
N. Shan States; yg. ad. ♂	4·7	2·5½	1·0	·9+	·9+	19	9 ×6	7½ ×8
N. Shan States; immat. ♀	4·4	2·2	·8	·8	·8	18½	...	...
Myitkyina (type) yg. ad. ♀	4·6	2·5	·8+	·8½	·9–	17	8 ×6	7 ×7

These measurements agree very closely with those of the skulls from Szechwan, Yunnan and Indo-China assigned by Thomas to *yunalis* and with the average of 4.7 in. in total length given by Allen for skulls of this race from Szechwan and western Yunnan. He found, on the contrary, that the average total length of a

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number of adult skulls of typical *larvata* from Fokien in S. China was only 4.4½ in., indicating the smaller size of the latter race.

PAGUMA LARVATA ROBUSTA, Miller.

Paradoxurus robustus, Miller, *Proc. Biol. Soc. Wash.*, xix, p. 26, 1906.

Paguma robusta, Kloss, *Journ. Str. Br. R. Asiat. Soc.*, No. 53, p. 24, 1909.

Paguma leucomystax robusta, Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xxvi, p. 51, 1918.

Locality of type: Trong or Trang, Peninsular Siam (Lat. 8° N.).

Distribution: Tenasserim, Peninsular Siam, Northern Malay Peninsula.

Distinguished from the more northern races by an average slight superiority in size and by the shortness and thinness of the coat at all seasons of the year, but principally by the large size and conspicuousness of the cream or white area of the cheek in front of the ear resulting from the forward sweep of the short hairs of the preaural fringe to form, where they meet the backwardly directed hairs of the rest of the face, a curved crest which passes only a short distance behind the eye. The general colour, hardly differing from that of some examples of *grayi* or *tytlerii*, varies from paler or darker tawny to buffy grey, the back sometimes with rusty ochreous speckling, but black or dark brown speckling of the coat on the back is never conspicuous, but usually more pronounced anteriorly, the nape sometimes being brownish. The pale fronto-nasal band is conspicuous and may be practically uniformly tinted throughout and fuse with the preaural patch or darkened between them; it may stop short on the crown between the ears or be continued on to the anterior portion of the nape; the rest of the mask is brown with the subocular patch represented at most by a grey smear; the belly is pale, creamy or greyish.

This description is based upon five examples collected by Kloss in Peninsular Siam and the northern parts of the Malay Peninsula, one of them, a large old ♂, being a topotype from Trang.

The evidence that this race comes into the fauna of British India rests upon the record by Miller of a specimen from Telok Besar in Tenasserim. This was an adult ♂, a little smaller than the type of the race, an adult ♀ from Trang, and much smaller, almost 5 inches shorter in the length of the head and body, than the topotypical ♂ above referred to. Miller did not give the measurements of the skull of the example from Telok Besar, but supplied those of the body taken in the flesh. In its size, the pattern of the mask, and in its skull this race resembles the long-known southern race *leucomystax* found in the southern Malay Peninsula, Sumatra and Borneo, but is much paler in general coloration, in which it is very like *grayi*. It is one of the annectant forms above referred to, justifying the view that *leucomystax* is a subspecies of *larvata*.

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PAGUMA LARVATA JANETTA, Thos.

Paguma robusta, Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xxiii, p. 710, 1915 (not *Paradoxurus robustus*, Miller).

Paguma leucomystax janetta, Thomas, *Ann. Mag. Nat. Hist.* (10), ii, p. 101, 1928.

Locality of type: Bankachon, Victoria Pt., S. Tenasserim.
Distribution: S. Tenasserim.

Distinguished from *robusta*, which it resembles in its short, thinnish winter-coat, large white or cream preaural area and some cranial features, by its much darker colour, the back being speckled with black and ochreous or buff, passing into grey on the

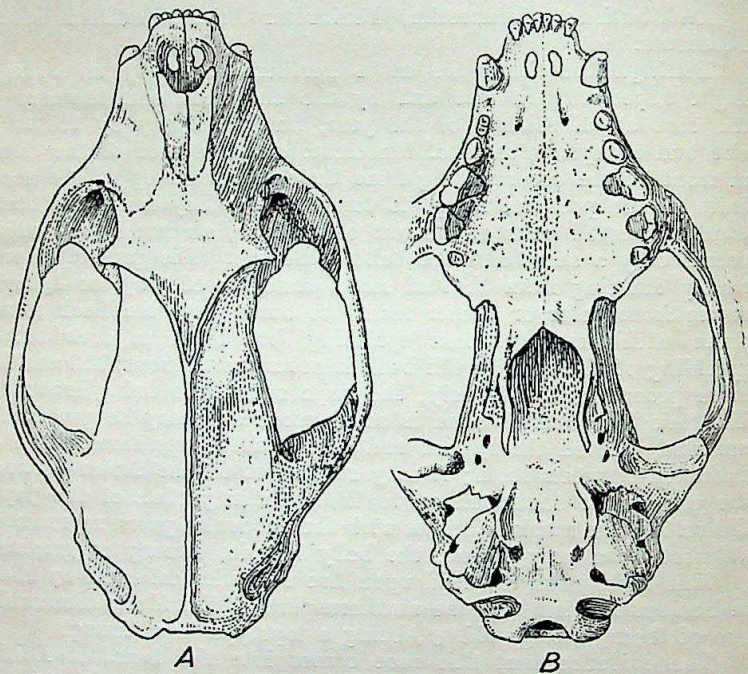

Fig. 7.—*A*. Upper and lower side of skull of oldish male (type) of *P. l. janetta* from Bankachon, Tenasserim.

flanks, but the pale speckling dies out on the shoulders and nape which are brownish black, with at most some white, continued back from the crown, in the middle of the nape.

The British Museum has three examples of this race collected for the Survey by G. C. Shortridge in Victoria, Tenasserim. They must have been assigned originally to *robusta* on geographical grounds without regard to Miller's description of that race. The type, an adult ♂ (No. 14.12.18.111) has no white on the nape or crown, no subocular patch, the grey fronto-nasal band narrowly continuous with the large preaural area and a pale brownish chin.

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An adult ♀ (No. 14.12.8.112) is a little paler on the upper side, the black speckling being less evident, the pale speckling more ochreous on the back and more buffy on the flanks; the fore part of the under side is darker grey, the chin blackish; there are a few speckles on the crown and an indistinct grey subocular patch. A more interesting difference lies in the preaural fringe, the hairs of which do not grow so far forwards, their disposition being intermediate between those of the type and of the more northern races. A young ♂ with milk teeth is like the adult ♂, but has a quantity of white on the nape, some on the crown and clean white facial areas, with the fronto-nasal band more clearly separated from the large preaural patch, and the chin black.

The following table gives the flesh measurements in inches and the coat in millimetres of the example of *robusta* from Tenasserim and of the three specimens of *janetta*:—

Locality, Date and Sex.	English Inches. Head and Body.	Tail.	Foot.	Coat in millim.	Weight.
robusta.					
Telok Besar, Tenasserim (Miller). ad. ♂	25⅜	22⅜	4	...	...
janetta.					
Bankachou, Tenasserim; Dec. 12; ad. ♂	26⅛	...	4⅜	20	12½ lbs.
Bankachon, Tenasserim; Dec. 27; immat. ♂	23⅛	20⅛	4—	...	6⅛ ,,
Bankachon, Tenasserim; Dec. 29; ad. ♀	25⅜	23	4	29	9¼ ,,

According to this table there is nothing to choose between *robusta* and *janetta* in size; but the only two males of *robusta* I have seen, namely an old example from Trang, the typical locality, and a young adult from Klong Wong Hip, both in Peninsular Siam, are considerably larger being, respectively 30⅛ and 29⅜ inches in length of head and body. This suggests that the Tenasserim example of *robusta* serves in a measures to link *robusta* and *janetta*, resembling the former in colour, the latter in size. In four examples of *robusta* from Peninsular Siam and the northern part of the Malay Peninsula, collected in October, February and March, the coat varies in length from 23 to 31 mm., which is about the same as in the examples of *janetta* collected in December. Both these races closely resemble *tytlerii* of the Andamans

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in the coat; but have it shorter than in *neglecta* and *intrudens* found farther north in British Burma. Typical *robusta* seems to be a little larger than *intrudens* and *neglecta*; the Tenasserim *robusta* and *janetta* seem to agree fairly well with those two races in size.

Skull measurements of *janetta*.

	In English Inches.					In Millimetres.		
Locality and Sex.	Total length.	Zygom. width.	Waist. width.	Int. orb. width.	Max. width.	Bulla.	Pm ^{4}.	M ^{1}.
Bankachon, Tenasserim (type) ad. ♂	4·9	2·9½	1·1	1·1	1·0	19	9×6	8×8
Bankachon, Tenasserim immat. ♂	4·4	2·3	1–	·9	·9	17	8×6½	7×8½
Bankachon, Tenasserim ad. ♀	4·6	2·5½	·9½	·8½	9·8½	19	8×6½	7×8

Judging from the flesh measurements, the skull of Miller's adult ♂ example of *robusta* from Tenasserim would not have exceeded in size that of the adult ♂ (type) of *janetta*. But the skull of the oldish ♂ of *robusta* from Trang above referred to, is 5.3½ in. long and 3 in. wide, and that of the adult ♀ (type), recorded by Miller, was 5 in. long and 2.7 in. wide, both being larger than the adult ♂ and ♀ skulls respectively of *janetta*, thus bearing out the conclusion derived from the flesh measurements that *robusta* is a larger form than *janetta*. The immature ♂ skull of the latter entered above carries its milk dentition, none of the permanent teeth being through the bone. The measured teeth were exposed by cutting away the maxilla.

The skulls of these two races are better developed muscularly than those of the preceding races. They exhibit a much more marked depression on the crown at the junction of the frontal and parietal bones and at this point the sagittal crest on the skull of the adult ♂ (type) of *janetta* is 5 mm. high, although in the adult ♀ there is no crest, the ridges being 5 mm. apart approximately, as in ♀ skulls of *grayi*. In skulls of *robusta* from Peninsular Siam the crest is still better developed. In an immature ♂, with milk teeth, the ridges just meet on the crown and in a young adult ♀ they rise into a low, sharp crest, as in the one oldish ♀ skull of *grayi* from Nepal.

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ON THE BIRDS OF THE ADUNG VALLEY, NORTH-EAST BURMA.

BY

N. B. KINNEAR.

[*Assistant Keeper, British Museum (Natural History).*]

In 1930 Captain Kingdon Ward accompanied by Lord Cranbrook made an expedition to the sources of the Irrawaddy with the object of studying the flora and collecting seeds of plants for introduction into British gardens. In his previous expeditions to Burma and Southern Tibet Captain Kingdon Ward always endeavoured to collect a few birds, but naturally having first to pay attention to plants, only when not engaged in botanizing or seed collecting has he been able to secure birds. Any lack of numbers however, has been made up in the rarity of the specimens secured. For instance, during his 1922 expedition he collected examples of *Tetraophasis szechenzii* in Yunnan and in 1924 obtained both Temminck's Tragopan (*Tragopan temminckii*), and Sclater's Monal (*Lophophorus sclateri*), in Southern Tibet, while in 1926 he got several specimens of the Yunnan Blood Pheasant, a new Trogon (*Pyrotrogon wardi*) in the Seinghku Valley, N. Burma.

In the present expedition Captain Ward was singularly fortunate in having as a companion, Lord Cranbrook, who was able to devote himself almost entirely to collecting zoological specimens. It says a great deal for Lord Cranbrook's zeal as a collector that with no previous experience and only one or two lessons in skinning he brought back some 152 birds, 340 mammals, a number of reptiles—one of which was new—and a collection of insects. Among the mammals four have been found to be new to science and I have described two new races amongst the birds.

The interest in the collection however, does not lie in the discovery of new forms but in the addition to our knowledge of the distribution of certain species. Some of the birds were previously only known from Nepal and Sikkim and N.-W. Yunnan and were unrecorded from any intermediate locality. While others again were known from the Himalayas and Assam, but not from Burma or further East. A number of the species are new to Burma, but exactly how many it is difficult to say definitely. In the second edition of the bird volumes of the *Fauna of British India*, certain species are stated to occur in Burma, but neither Dr. Ticehurst, who has made a very complete bibliography of Burmese birds, nor I, have been able to trace any published record and there are no skins in the Museum from Burma.

The field notes made by Lord Cranbrook are distinguished by a (C) and those by Captain Kingdon Ward with (K. W.). All references to the *Fauna* should be understood as meaning the volumes by Mr. Stuart Baker in the second edition of the *Fauna of British India* series.

Out of the 152 skins in the collection 88 were presented by Lord Cranbrook and Captain Kingdon Ward to the British Museum, the remainder going to the Field Museum, Chicago.

Lord Cranbrook has kindly contributed the following account of the trip and the country visited.

NARRATIVE OF THE EXPEDITION.

BY

LORD CRANBROOK.

The object of Captain Kingdon Ward's 1931 Expedition was, of course, mainly botanical, though we hoped to cross the pass at the head of the

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Nam Tamai valley into Tibet, and link up our route with that of any other traveller further north. I was to make as representative a collection as I could of the birds and mammals.

We arrived at Rangoon in November 1930 and proceeded to Myitkyina by train, travelling from there by mules to Fort Hertz, where we arrived on December 16th. Owing to the regulations of the Yunnan Government, Chinese mules working in Burma are not allowed east of the Mali Hka, so after leaving Fort Hertz we had to rely on coolies for transport. As the country is very sparsely inhabited and we were taking stores for a year, it meant that travelling was slow and that we were separated from part of our kit for days at a time, so it says much for the honesty of the inhabitants that, though we had about a hundredweight of coined silver, to say nothing of a case of rum bottles—which even empty were almost priceless to the natives—we never missed anything!

Between the Mali Hka and the Nam Tamai we had to cross three ranges of about 6,000 ft. dropping down to the valleys between each at about 1,500 ft.; the road, a good mule path, running through evergreen hill jungle. Reaching the Tamai on January 7th we travelled up its east bank, arriving at the Adung-Seinghku confluence on the 25th. Up to the time we crossed the last range of hills which separates the Nam Tamai (one of the head waters of the Nmai Hka, or Eastern Irrawaddy) from the last tributary of the Mali Hka, or Western Irrawaddy, we heard or saw Gibbons every day: after crossing the divide some 6,500 ft., we never saw or heard any and the natives told me they were not to be found. This pass is the lowest over the divide until many miles further south in the Triangle, and it would be interesting to find out how far north from the plains near Myitkyina these monkeys go in the valley of the Nmai; the vegetation and climate seem to be exactly the same both sides of the divide.

The Adung-Seinghku confluence (the Tamai from now on changing its name to Adung) is the end of administrative territory and from now we had to rely on native tracks and more primitive bridges. Going was pretty slow as the path was not good for laden coolies: sometimes climbing small cliffs on bamboo ladders or knotched logs, then down amongst the boulders in the river bed with occasional easier places where it crossed cultivated terraces. The houses of the natives were all hidden away in the jungle but signs of inhabitants were not wanting in small patches of cultivated land and occasional 'monkey bridges' over the river. On the fourth day the valley turned to the north and there seemed to be a definite change from typical subtropical hill jungle to forest of a more temperate type. Conifers were quite numerous in the valley bottom and there were a good many deciduous trees: even the fauna seemed to change as above this bend I saw none of the red-bellied *Callosciurus erythraeus* which were so plentiful in the Tamai and Lower Adung, and the long-nosed Squirrels (*Dremomys pernyi* and *D. macmillani*) seemed to take their place. The next day we arrived at Tahawndam, the last village in Burma, which we made our base and where we were to stay for the next three months.

The village itself consisted of three Tibetan families while there were about six Daru families scattered up and down the valley. There was also one family who claimed to be Dalons, of a different race to the Darus and to have come from over the hills to the South (? Taron valley): to my mind they appeared identical with the Darus,—looking the same, clothed the same, just as smelly and dirty and, after their first fear of us—just as friendly.

The Tibetans seemed to do themselves pretty well with a few acres of permanent cultivation round their huts and fair sized herds of yak, sheep, goats, pigs and a few fowls. They plough with yak and grow barley, maize, peas, beans, millet and buckwheat. Although they do not seem to have any fixed rotation they grow two crops a year with an occasional fallow. The leguminous crops are varied from field to field and they spread their litter from the byres on the fields before ploughing. The plough only scratches the surface of the ground, but the fields are thoroughly cultivated and the crops kept moderately clean by hand-hoeing; this latter work being done by the women and Darus. The men do the ploughing which I found not nearly such hard work as using an English balance plough. The hoe used being merly an 'L' shaped branch, sometimes iron-shod, but usually fire hardened. The Tibetan headman hunted takin, gooral, serow and barking deer with dogs, shooting

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them either with a matchlock or crossbow and poisoned arrows: he was a bad shot with either and must have got very close to kill. They kept no bees but collected wild honey: the early flow (mainly from rhododendrons) is poisonous and like Xenophon's Greeks with their Pontine honey I fell a victim to my greed and one day had to crawl back to camp, fainting at intervals, after a comparatively small helping.

We stayed three months at our base camp until the snow melted enough to allow us to move up the valley. During that time February-May 1931, I made the bulk of the collection of birds and during the last few weeks we were constantly noticing fresh arrivals as the migrants came up the valley. There was also a smaller local movement up the sides, the birds constantly pressing on the rear of the retreating snow.

Our second camp was three days' march, some 14 miles, up the valley at 8,000 ft. At this height there was a great difference in both fauna and flora: the trees were about half Conifers and, to the non-botanist the rest of the forest seemed to be rhododendrons with which the whole valley was ablaze. Voles appeared for the first time, and the shrews and mice were quite different from those at the base camp. Only the monotonous spring call of *Leioptila pulchella cœruleotincta* of the bird noises from down the valley followed us still. While we were here on May 21st two Tibetans crossed the Namnila and when we moved camp again on June 6th we were thinking optimistically of crossing ourselves in the near future. The next two marches brought us within 2 hours of the foot of the pass and we established our top camp at 12,000 ft. by a very pleasant meadow, carpeted at the time of our arrival with flowers and later with a very excellent strawberry. While later there was an even better raspberry. Both these latter unfortunately have refused to grow from seed!

Owing to transport difficulties we had to stay here for three months during which time we got to know the surrounding valleys pretty well. The absence of large mammals was very noticeable though there were much deer droppings in the forest. We were out every day and in all weathers but never saw anything larger than a Weasel (*Mustela subhemachalana*); Pigmy Hares (*Ochotona roylei nepalensis*) and Voles (*Anteliomys wardi*) were very common and their runs made amongst the rhododendron, juniper and cotoneaster were everywhere: as these runs were very conspicuous in places where the snow had recently melted I think they must move about under the snow to a certain extent during the winter. We were lucky enough to get two of Temminck's Horned Tragopans, and several Kusier's Blood Pheasants which with some Snow Pigeons were all the fresh meat we were able to get. The Pigeon and Blood Pheasants were pleasantly tame for one shooting for the pot but unfortunately not common: the Tragopans were neither tame nor common. There was also a large red fungus which grew on dead pine trees; this cooked with wild garlic made a very savoury dish. Our cook who, like myself, was out of tobacco used to smoke the dried leaves of an aster: my cravings were not so bad as his so I did not try it, but he assured me that it smoked well. Other local products were an aconite of which the roots were collected by the villagers from lower down used to make arrow-poison, and the bulbs of a fritillary to collect which several gangs of Chinese and Tebetans crossed the pass during our stay: from what I could make out they are a cure to every ill that the flesh is heir to whether taken internally or applied externally to wounds or broken limbs!

As the snow melted we were able to make out more and more of the surrounding country and found that the Adung has its source in a glacier at a height of about 14,000 ft. This glacier, though now in retreat with a typically convex snout, must at one time have gone down the valley almost to its junction with the Seinghku, the sides of the valley being almost entirely free from spurs and in places obviously ice worn.

Meanwhile we had sent repeated requests for coolies to the headman of Tahawndam with no result but excuses, so after some time we persuaded a gang of Chinese root-hunters to take us over the pass though they were apparently too frightened of the Tibetans to promise to take us beyond the first village the other side. We left on September 1st with 10 half loads on a wet misty day. We found the height of the pass to be 15,000 ft. after the usual trouble with the boiling point apparatus in wind and snow: any scientist who could invent a b.p. apparatus in which the water will not all evaporate

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before it boils, or will boil before the spirit burns away would earn the gratitude of all travellers in mountainous country!

The path to the pass runs eastward from the foot of the glacier at the head of the valley, and after crossing the pass descends steeply over a stone screen and a snow bed to a lake lying some 1,500 ft. below. Descending steeply it turns north down a stream which rises in three glaciers to the south. The stream is about ¾ mile joins another larger stream which rises in two other glaciers to the west and north-west, one of these glaciers being split in two by a slowing down on either side of an enormous pillar of black rock. We had to ford the larger stream which though only knee-deep, ran fast and was extremely cold, after which we reached trees at 13,000 ft. and camped for the night, with smooth ice cliffs rising above our camp on both sides of the valley. The next day we travelled down the combined stream, now running east, to a large open pasture over which yak, sheep and goats grazed, and which swarmed with extremely voracious mosquitoes. The latter had all gone by our return at the end of the month. This was a short easy march through fairly open forest with large luscious raspberries growing in the more open spaces. On September 3rd we marched down the valley in a north-east direction along a good mule path crossing the Shori Chu, a tributary which joins the main river from the west, shortly before halting for the night: a path goes to Drowa Gompa up the Shori and is the direct route from the Adung valley to the Tibetan province of Zayul. The river here turns east and finally at the end of the next day's march, where it is joined by the Lokong Chu, to the south-east, eventually of course to join the Taron. On a shelf, probably the old glacier bed, some 500 ft. above the Lokong confluence and at a height of 10,350 ft. we came to the village of Jite and beyond this we were unable to go. All the able bodied men were away with the cattle at the summer grazing camps, and the old men who were left were not very friendly so in one way or another we could not get transport to go any further. One day I followed the Ridong road, which here leaves the river and runs north-east crossing 3 passes and 2 rivers between Jitte and Ridong, to the top of the first pass, the Lachong La (13,100 ft.), and with that we had to be content.

At the time of our arrival the corn had all been cut and the old men and women were carrying it, each sheaf being tied up with a wisp of straw from which the ears were first carefully cut and put in a basket. The hay too had been cut and was hanging on to the sides of the houses or festooned in the trees to dry—and yet we in England often grumble at a wet haysel! At this height there was no maize, but barley, oats, peas, turnips and, rather surprisingly, potatoes. The corn was badly rusted, as one might expect with many species of barberry growing round the fields. We had taken no arms with us for fear of offending the religious susceptibilities of the Tibetans, so that collecting was difficult. For the same reason I did not like to set traps, but the cook jumped on a mouse in a granary which I skinned *faute de mieux*, hoping much of my one Tibetan mammal. It turned out to be *Apodemus speciosus latronum* of which I had collected innumerable specimens on the other side of the pass at all heights from 2,000-12,000 ft.

Finally we left for home on September 20th, crossing the Namni La, on which there was a little fresh snow, on the 23rd with some little anxiety for our kit as we had to carry it on ponies to the foot of the pass and the coolies had to make two journies to bring it over. When the Tibetans left us at our 12,000 ft. camp, Kingdon Ward, the cook and I found ourselves rather stranded as we had only a little food left; so I left Kingdon Ward with the cook to collect his seeds, and, carrying a blanket, a hot water bottle and some food, made my way down to the base camp, sleeping under rocks etc. at night, to send some food up and to wait the return of our other servant whom we had sent back to Fort Hertz with our mail. When I arrived at the base I found that our hut had been buried under a rockslide (fortunately we had stored all our stuff in the headman's granary) so I stayed with one of the Tibetans for a week: board, lodging and service at Rs. 1-8 a day. They fed me plentifully but I found sleeping on the floor in the general heap of grown-ups, children and slaves rather trying and was glad to get away to a new camp at 10,000 ft. where Kingdon Ward joined me on October 19th. We got to our base camp once more on November 2nd and on the 20th we broke camp for the last time and reached Myitkyina on January 1st 1932 after an absence of just over 13 months.

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SYSTEMATIC LIST.

BY

N. B. KINNEAR.

Corvus macrorhynchos macrorhynchos Jungle Crow.

156 ♀ October 12, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.
Crows are recorded several times in Lord Cranbrook and Captain Kingdon Ward's notes but as some of these may refer to Carrion Crows I have not given them. The above specimen is an adult with the wing still in moult and has a bill measuring from base of skull 61.5 mm.

Urocissa erythrorhyncha erythrorhyncha Chinese Red-billed Magpie.

117 ♀ May 22, Adung Valley 28°15′ N., 97°46′ E., 8,000 ft.

Cissa chinensis chinensis Green Magpie.

6 ♀ January 12, Nam Tami, 4,000 ft.
Caught in a trap baited with meat [C].

Garrulus bispecularis sinensis Chinese Jay.

Garrulus sinensis Swinhoe, Proc. Zool. Soc. 1871, p. 381—Foochow.
112 ♂ May 20, Adung Valley, 28°15′ N., 97°40′ E., 8,000 ft.
Shot in fairly thick jungle [C].
This is the bird mentioned as *G. b. rufescens* in the key to *Garrulus bispecularis* in the *Fauna*. As Lord Rothschild has pointed out *G. b. rufescens* Reichenow is a synonym of *G. b. sinensis*. A new record for Burma.

Nucifraga caryocactes yunnanensis Yunnan Nutcracker.

Nucifraga yunnanensis Ingram Bull. B.O.C., xxv, p. 86 (1910)—Mts. of Yunnan.
110 ♂ juv. May, Adung Valley 28°15′ N., 97°40′ E., 7,500 ft.
Shot on the March, alarm note a harsh croak [C.].

Parus monticolus yunnanensis Yunnan Green-backed Tit.

Parus monticolus yunnanensis La Touche Bull. B.O.C., xlii, p. 51 (1921)—S.-E. Yunnan.
32 ♀ February 22, 79 ♂ April 5, 105 ♀ May 13, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.
Very common. February 28. I don't know whether tits are migratory but the last two days I have seen many more similar to No. 32 than ever before, usually in small parties between four to a dozen [C.].
March 6. Attacks the flowers of *Rhododendron tanestylum* and is perhaps responsible for some of the bitten through corallas. March 8. The last bush of *R. tanestylum* is now finished. I saw four tits in it at one time and the corallas were dropping fast. March 9. Very fond of *Rubus lineatus* and the tits are always found there in the early morning. April 11. Almost the commonest bird here is now busy collecting materials for its nest [K. W.].
In Manipur and on Mt. Victoria this race is represented by *P. m. lepcharum* of the Eastern Himalayas.

Lophophanes ater aemodius Himalayan Cole-Tit.

159 ♂ October 22, Adung Valley 28°15′ N., 97°45′ E., 10,000 ft.
One of a flock of about fifty [C.].
This specimen does not differ from Nepal and Sikkim examples. It was obtained by both Rippon and Forrest in Yunnan but has not been found in Burma previously.

Lophophanes rufonuchalis beavani Sikkim Black-Tit.

139 ♂ July 6, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.
Shot in jungle; fairly common, habits much like any other tit, but not so

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active or acrobatic as some. Also seen in September in Tibet 28°25′ N., 97°55′ E. [C.].

New to the avifauna of Burma.

Ægithaliscus bonvaloti Chinese Black-headed Tit.

26 February 19, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

One of a flock, common [C.].

According to the *Fauna*, this Tit is found in 'Western China, Yunnan and N.-E. Shan States. There are several specimens from the last named place in the British Museum Collection'. Previous to the receipt of the above specimen no examples of this Tit existed in the Museum Collection from anywhere in Burma. Rippon, however, got a number in Yunnan, Gyi-dzin-Shan, Lichiang, etc. and Forrest also collected many examples in the same area.

Sitta europæa nebulosa Nuthatch.

Sitta europæa nebulosa La Touche Bull. B.O.C., xlii, p. 55 (1921)—Mittai, S.-E. Yunnan.

22 ♂ February 17, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Fairly common [C.].

In the *Ibis* 1899, p. 404, La Touche described the nuthatch from Fokien as *Sitta montium* and some years later separated the bird from Miltai, S.-E. Yunnan as *S. e. nebulosa* on account of certain colour differences and larger size. Hartert considers the birds from Yunnan—Lichiang Range to Miltai—and Szechuan to belong to the last mentioned race, but all our specimens from the latter locality are *S. e. sinensis*. There is very little difference in colour between Lichiang and Fokien birds but the former were distinctly larger.

	Wing.	Bill from skull.		Wing.	Bill.
6 ♂	Fokien 72-78	17·5-18·5	13 N.-W. Yunnan	75-84	17-19
3 ♀	Fokien 71-74	16·5-18·5			

The hind claw is said to be larger in *S. e. nebulosa*, but I do not find that a constant character. We have several specimens of the present race in the Museum from the South Shan States collected by Rippon, Thompson, Craddock and Venning but no mention is made in the *Fauna* of this bird occurring there, while the three examples from the Kauri Kachin Hills (Rippon) are apparently recorded as *S. e. nagaensis*. Harington also notes this bird from the same area and said it was plentiful in the hills.

Dryonastes cærulatus kaurensis Kachin Hills Laughing Thrush.

98 ♂ April 23, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

One of a flock of about six [C.].

Rippon collected two specimens east of Bhamo and Harington two a Sinlum. A single male obtained by Forrest on his last trip does not differ from these and I think therefore that *D. c. latrifrons* Rothschild (Shweli-Salwin Divide) must be considered a synonym of *D. c. kaurensis*.

Trochalopterum erythrocephalum forresti Forrest's Red-headed Laughing-Thrush.

Ianthocincla forresti Rothschild Nov. Zool., xxviii, p. 35 (1921)—Shweli-Salwin Divide.

23 ♀ February 17, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

One of a flock. Crop full of seeds of probably some sort of ivy, also one ant and the pupae of a fly [C.].

Shot a new babbler which goes about in flocks. These birds have several calls; the normal seems to be a sort of hissing whistle on two notes. I surprised a flock in a tree and they flew one by one into the bushes. Then I sat down and one bird came to scout for me and settled on a bush just above my head and on perceiving me gave the warning signal and flew back to the others [K. W.].

I do not understand why Lord Rothschild should consider *forresti* a very distinct species and not a race of *erythrocephalum* since it is very near *T. e. woodi*, only differing in the greener back and darker underside. Forrest obtained specimens on the Shweli-Salwin divide and at Tengyuedh and Rippon collected a single example in the Kauri Kachin District in July 1901.

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Trochalopterum affine oustaleti Oustalet's Laughing-Thrush.

Ianthocincla affinis oustaleti Hartert Vög. Pal. Fauna, i, p. 633—Tsekou, Yunnan.

45 ♀ March 5; 48 ♂ March 6, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.; 115 ♂ May 27, Adung Valley 28°20′ N., 97°40′ E., 9,000 ft.; 121 ♂ June 12, Adung Valley 28°20′ N., 97°40′ E., 8,000 ft.; 122 ♀ June 8, 137 ♂ July 4, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.

45 not uncommon. Usually goes about in flocks, sometimes singly. Rather silent and wary. 48 shot in low undergrowth, singing somewhat mournfully and extremely monotonously by himself. The song is only four notes constantly repeated. 115, 121. Common. 137 shot in forest, common. This bird goes right up to the limit of trees, but I have never seen it in the scrub higher up, though there is a pair in the last isolated patch of forest. Seen also during September in Tibet 28°25′ N., 97°55′ E. [C.].

45 crop contained 50 seeds of *Rubus* and over 50 of *Gaultheria* besides other seeds and remains of at least one beetle. 48 seeds of *Viburnum* (9223), 8 of *Rubus lineatus* and over 50 of *Gaultheria* (9248) [K. W.]

From *T. a. affine* this race differs in the darker head—in some examples black, in others blackish brown—less rufescent back and paler underside which is distinctly greyer. It is found in northern Yunnan and east to N.-W. Szechuan. 13 ♂ wing 102-118, 11 ♀ wing 101-109.

Trochalopterum subunicolor griseata The Yunnan Plain-coloured Laughing Thrush.

Ianthocincla subunicolor griseata Roths. Nov. Zool., xxviii, p. 33 (1921)—Shweli-Salwin Divide.

124 ♂, 125 ♀ June 13, Adung Valley 28°20′ N., 97°40′ E., 13,000 ft. Over Alpine Meadow. Iris yellow.

June 13. A new Babbler, with speckled breast, along with its mate was hopping in and out through the bushes after *Rubus* berries. From time to time they hopped up onto the top of a *Rubus* bush and getting the two in line I secured both [K. W.].

This race of the Plain-coloured Laughing Thrush was described by Lord Rothschild in 1921 from five specimens collected by Forrest on the Shweli-Salwin Divide in August 1919. It differs from the typical bird in the more olive and less rufous colour of the upper parts, especially on the rump, darker slaty head, darker throat and paler breast and abdomen, the feathers of which have larger squamations.

Ianthocincla s. subunicolor was described from Nepal and ranges east to the Dibang River, while the present race is known from the Adung Valley and the Tengyueh District and Shweli-Salwin Divide in Yunnan. It is a bird of high altitudes and Forrest did not find it below 7,000 ft.

Measurements of *T. s. griseata* 3 ♂ 92-95; 2 no sex 95; 1 ♀ 95.
T. s. subunicolor 1 ♀ 87, no sex 87-94.

Grammatoptila striata cranbrooki Cranbrook's Striated Laughing Thrush.

Grammatoptila striata cranbrooki Kinnear, Bull. B.O.C.

7 ♂ January 28, Nami Tami, 4,000 ft., 90 ♀ April 16, 99 ♂, 113 ♂ April 24, Adung Valley 28°10′ N., 97°40′ E., 6,000-8,000 ft.

No. 7 shot in bamboo forest, goes about in flocks but often seen singly. Fairly common, alarm note like a blackbird when alone [C.].

No 90. Crop full of seeds, almost entirely *Rubus lineatus* and a few of *Gaultheria* [K. W.].

The Striated Laughing Thrush has not previously been recorded from Burma, though in Assam it is said to be found as far east as Margherita.

These four specimens are darker on the mantle and rump than in *G. s. austeni* and in size run larger.

	Wing.	Bill from Skull.	Tail.
10 ♂ Dafla Hills	137-145	29-31·5	120-129
3 ♂ Nami Tamai & Adung Valley.	141-152	31-32	120-135
3 ♀ Dafla Hills	136-143	31	127-130
1 ♀ Adung Valley	152	31	135

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Fulvetta vinipectus bieti Yunnan Fulvetta.

Alcippe (Proparus) bieti Oustalet, Ann. Sci. Nat. (ser. 7), xii, p. 283, pl. ix (1892)—Ta-Tsien-lou.

25 ♀ February 18, 47 ♀ March 5, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

No. 25. Brought in by a small boy, who shot it with a crossbow. Crop contained small seeds. No. 47. Very common goes about in flocks chattering continuously and methodically searching low trees and undergrowth [C.].

These birds agree with a series collected by Forrest on the Lichiang Range Lat. 27°20′ N. in Yunnan.

Leioptila pulchella cœruleotincta Yunnan Beautiful Sibia.

Leioptila pulchella coeruleotincta Rothschild Nov. Zool., xxviii, p. 38 (1921)—Shweli-Salwin Divide.

8 ♀ January 28, Tamai Valley 4,000 ft., 24 ♂, February 18, 37 ♂ February 24, 58 ♂ March 11, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

No. 8. Shot sitting high up on a dead tree. One of a flock of about eight or ten.

No. 24. Goes about mainly in flocks, occasionally singly. Makes a continual chattering while searching trees and shrubs and often sits up in the top branches of a dead tree. Very common. No. 37. This bird had its breast covered with Rhododendron pollen like many at this time, making a broad yellow streak down its breast, so that it looked like a different species altogether. Small parties often sit on clusters of rhododendron flowers putting their beaks right down inside and probably do a good deal towards fertilizing the flowers. During the last week or so this bird has developed a somewhat annoying call rather like a redshank's but with three other notes of the same harshness introduced [C.].

February 24. At last I shot the five-note bird we hear every morning and it turned out to be the Yunnan Beautiful Sibia. Its throat was yellow, feathers yellow-tipped as I thought, like the first one I saw in a few days ago, which was uttering a very different cry. This yellow however was the pollen from *Rhododendron tanestylum* and I watched a bird put its head inside the flowers to suck the honey apparently. Often sits on the top-most twig of a tree surveying the landscape for a few minutes on end. It is rather the buffoon amongst birds, has as many calls as a starling and is a very cheerful bird [K. W.].

This Sibia is another of Forrest's discoveries in north-west Yunnan, where it is not uncommon. From the Beautiful Sibia *L. p. pulchella*, inhabiting the Naga, Nuri and Dafla Hills, it is distinguished by the bluish-grey colour of the underside.

Actinodura nipalensis wardi Ward's Bar-wing.

Actinodura nipalensis wardi Kinnear Bull. B.O.C., liii, p. 79 (1932)—Adung Valley.

71 ♂ March 27, 85 ♂ April 13, Adung Valley 28°10′ N., 97°40′ E.

71. Seen alone, breast covered with rhododendron pollen. I have not seen this bird down in the valley. 85 shot in low bamboo: one of a pair [C.]. In the gizzard of No. 71 I found only plant remains (probably moss). No. 85 had seeds in gizzard, mostly *Rubus lineatus*, one of *Ardesia* and a few insect remains [K. W.].

This new race of Bar-wing differs from *A. n. waldeni* Godwin-Austen (Japvo Peak, Naga Hills) in the darker colouration of the back, blacker crest and richer brown on the underside.

A. n. waldeni is found on Japvo and Khunho Peaks in the Naga Hills and Owenkulno Peak in Manipur and further south on Mt. Victoria is a very doubtfully distinct race *A. n. poliotis* in which the only difference seems to be that the crest is darker. To say that *A. n. poliotis* is much darker than *waldeni*, as we read in the *Fauna*, is not in accordance with the specimens in the British Museum. From Yunnan Lord Rothschild has described a further race *A. n. saturator* (Shweli-Salwin Divide) which differs from *cranbrooki* in the presence of pale edges to the feathers of the crest, mantle and underparts, the crest too is paler and the barring more pronounced.

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There is in Calcutta a specimen of *Astinodura nepalensis* collected by Anderson at Ponsee which may be this race or *saturator*.

Yuhina gularis griseotincta Yunnan Yuhina.

Yuhina gularis griseotincta Rothschild, Nov. Zool., xxviii, p. 42 (1921)—Shweli-Salwin Divide.

64 ♀ March 14, Adung Valley 28°10′ N., 97°40′ E., 8,000 ft., 118 ♀ March 30, 28°10′ N., 97°40′ E., 6,000 ft.

Shot in low bamboo forest [C.].. Had *Rhododendorn grande* pollen on breast feathers [K. W.].

The name *Yuhina yangpiensis* was given by Sharpe (Bull. B.O.C., xiii, p. 12, 1902) to a single specimen collected by Colonel Rippon on the Yangpi-Talifu Road, W. Yunnan on 22 March 1902 and given to the Museum in 1903 Apparently Rippon got no further specimens, at least there are none in the Museum, but two years later in 1904 he made a collection on Mt. Victoria and secured a series of a Yuhina in March and April which are quite indistinguishable from the type of '*yangpiensis*' and moreover I can see no difference between them and the typical form from Nepal. In 1921 Lord Rothschild described *Y. g. griseotincta* which differs from *Y. g. gularis* in having the sides of the head and neck greyer, the throat and chest more vinaceous.

Ixulus flavicollis rouxi Chestnut-naped Ixulus.

Ixulus rouxi Oustalet, Bull. Mus. Paris, ii, p. 186 (1896)—Ly-Sien-Kiang, Yunnan.

15 ♂ February, Adung Valley 28°10′ N., 97°40′ E., 8,000 ft.; 86 ♂ April 14, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Very common, goes about in flocks methodically searching bushes and trees keeping up a continual chatter all the time [C.].

I can see no difference between examples from Sinlum, Bhamo Hills, from where Harington's *I. f. harterti* was described, and specimens from Yunnan. This species has a wide range and extends from Tonkin to Yunnan, Mt. Victoria and S. Assam. Harington recorded the Chestnut-naped Ixulus as fairly common near Bhamo and Rippon also obtained it there.

Leiothrix lutea yunnanensis Yunnan Red-billed Leiothrix.

76 ♀ April 3, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

I have not seen this bird until two days ago, but it seems to be fairly common [C.].

Harington records this race in the Bhamo District and Anderson got six examples from near Ponsee.

Pteruthius ænobarbes melanotis Chestnut-headed Shrike-Babbler.

33 ♂ February 22, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Fairly common; goes about in flocks [C.].

In the *Fauna*, *P. a. melanotis* Hodgson is given as ranging from Nepal to Manipur and *P. a. intermedius* Hume (Mooleyit) the Eastern hills of Burma from Bhamo to Tenasserim. This distribution is not however confirmed by the specimens in the British Museum. Of the former there are examples from Nepal, Sikkim, Naga Hills, Manipur, N. Chin Hills, Mt. Victoria, Kauri Kachin District (Rippon), Shweli-Salwin Divide (Forrest), Loi Pangnan, W. of Mekong, S. Shan States (Craddock) and a single ♂ from Ngoi, Toi, Tonkin (Stevens). Of *P. a. intermedius* there are specimens from Mooleyit, Thoungyeen, Tonghoo, Loi Maw, Kentung, S. Shan States (Rippon), Chapa, Fan-si-pan, Tonkin (Delacour). It appears therefore that the S. Shan States and northern Tonkin are the meeting places of the two races, but there is no sign amongst the few specimens examined of intergradation. In addition to the specimens mentioned above of *P. a. melanotis* Harington collected three birds near Bhamo.

Myzornis pyrrhoura Fire-tailed Myzornis.

73 ♀ March 28, Adung Valley 28°10′ N., 97°40′ E., 8,000 ft.

Goes about in flocks, chattering and methodically searching bushes and low trees, sometimes makes flights like a flycatcher. Common here but I have not seen it in the valley. Breast covered with Rhododendron pollen [C.].

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In the *Fauna* the distribution of this species is given as Nepal and Sikkim, but in 1901 Oustalet recorded an example from Tsékou and more recently it has been collected by Forrest in Yunnan.

Microscelis leucocephalus leucocephalus Chinese Black Bulbul.

77 ♂, 78 ♂ April 3, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

One of a party of three which by their behaviour were two males in pursuit of a female. I have not noticed them before. No. 78 had the gizzard full of large seeds. Also seen in May at 8,000 ft. [C.].

Rothschild and Stresemann have shown that the race of this Bulbul in China polychromatic (Nov. Zool. 1926, xxxiii, pp. 301-2 and Ornith Monatsb. 1923, pp. 83-5) and in Yunnan is found in four different phases. These two birds belong to the *sinensis* phase with glossy black locks and crests which has not been recorded from Burma before.

Ixos macclellandi similis The Yunnan Bulbul.

Hemixus macclellandi similis Rothschild.

103 ♂ May 3, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

One of a pair [C.].

This specimen has rather more chestnut-brown on the cheeks, sides of neck and breast than the majority of birds from N.-W. Yunnan, though one from Gyi-dzin-Shan, E. of Talifu is similar. Rippon obtained examples in the Kauri Kachin District at over 5,000 ft.

Pycnonotus aurigaster xanthorrous Anderson's Yellow-vented Bulbul.

36 February 24, Adung Valley 28°10′ N., 97°40′ E., 104 ♂ May 4, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Fairly common [C.].

Certhia familiaris khamensis Tibetan Tree-Creeper.

130 ♂ June 25, Adung Valley 28°20′ N., 97°45′ E., 13,000 ft.

A bird seen in September in Tibet 28°25′ N., 97°55′ E., probably also belonged to this species [C.].

Harington observed Tree-Creepers which he took to be *C. f. nipalensis* in the Kachin hills which doubtless belonged to this race as Baker suggests, but this is the first actual record.

Troglodytes troglodytes talifuensis Yunnan Wren.

56 ♂ March 9, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Sharpe described this bird from an example collected by Rippon at Gyi-dzin-Shan, East of Talifu in Yunnan. This specimen is an exceptionally pale bird with the white spots on the wing coverts larger than usual. The Yunnan series only differs from Nepal and Sikkim examples in the rather paler underside.

In the *Fauna*, Baker includes the Shan States in the distribution of this Wren, but the only skins in the Museum collection are from Yunnan.

Oligura castaneo-coronata Chestnut-headed Wren.

111 ♂ May 19, 1931, Adung Valley 28°15′ N., 97°40′ E., 8,000 ft.

Shot in fairly thick forest, very common here and seen occasionally down at 6,000 ft. [C.].

In the *Fauna* the distribution of this bird is said to be Himalayas from Garhwal to the extreme East of Assam: the Khasia, Naga and Cachar Hills South of the Brahmaputra but not recorded from Manipur or further South or East. There is however in the British Museum a series collected by Rippon on Mt. Victoria, four examples from Loi Maw, S. Shan States (Rippon) and several from N.-W. Yunnan, Lichiang Range (Forrest). I can see no difference in colour between Himalayan examples and those from Burma but in size the Yunnan and S. Shan States birds run large.

4 ♂ Yunnan	52-55 mm.	Sikkim 1 ♂	49
1 ♀	50	1 ♀	50 mm.
4—Shan States	53-55,	5—46-52	
Mt. Victoria 9	47-50 mm.		

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Cinclus pallasi marila Formosan Brown Dipper.

44 ♀ March 4, 89 ♀ April 15, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

44. Fairly common. Always seen along the river, standing on stones and diving for food. I have seen it dive off a rock about a foot above the water level, but usually from the edge of the water. Swims a little occasionally and I have once seen it dive when swimming. Very weary and shy; call like our ouzel at home.

89. Lately seen in greater numbers. I have seen it swimming in a rapid stream—about a six knot current—deliberately alight on the water and swim a considerable distance to land [C.].

There is no difference in colour in the Brown Dippers found from Assam to Formosa, though in size they vary considerably, but unfortunately we have not a good series of sexed birds from the extremes of the bird's range.

10 ♂ Fokien and Shensi	109-117 mm.	♀ Szechuan 117, probably wrongly sexed.	
1 ♂ S. Shan States	109 mm.		
2 ♂ Assam	100-102 mm.	2 ♀ Adung Valley and Assam	100-102 mm.
17 ♀ Fokien, Chekiang and Shensi	105-110 mm.	1 ♀ Formosa	96 mm.

For the large Chinese bird the name *soulie* Oustalet, type locality Ta-tsien-lu, is available and for that from Formosa *marila* of Swinhoe. Without further material it is impossible to decide whether the Assam and Formosa birds are different and for the present they must be treated as the same. In the *Ibis* 1907, p. 177, Messrs. Grant and La Touche state that the young of *soulei* can be distinguished from *marila* by the different colour of the crossbars on the underside but from the material in the Museum this does not appear to be the case.

Rhodophila ferrea haringtoni Eastern Dark-grey Bush-Chat.

92 ♂ April 17, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

I have not seen this bird before [C.].

Harington found this species breeding near Bhamo and Rippon collected a young bird.

This is an unsatisfactory race and further breeding birds are wanted from South China. Hartert (Vög. Pal. *Fauna*, vol. i, p. 711) separated the Eastern bird from that of the Himalayas on account of the length of the tail which in *O. ferrea ferrea* he gives as 63-68 mm. as against 57-61.5 in *O. f. haringtoni*. Baker, however, in the *Fauna* points out an additional difference and says that *O. f. haringtoni* is distinguished 'in being whiter below at all seasons of the year, in summer the breast and abdomen are almost pure white.' After examining a large series I can see no difference in the colour of freshly moulted autumn birds from S. China and the Himalayas, but in the spring and summer when the plumage is abraded, western birds—the reverse of what Mr. Baker says—are certainly very white below but unfortunately we have practically no birds at this season of the year from S. China.

The measurements of the tails of the series of males examined is:

21 Simla, Sikkim, Manipur	59-65
4 Arakan and Chin Hills	58-65
7 Karen Hills	56-60
10 Yunnan	55-61
3 Szechuan	53-58
11 S. China	56-60

The type of *O. f. haringtoni* was collected at Lieng-Kiang near Foochow on January 18 and not at Moupin, as stated in the *Fauna*.

Microcichla scouleri scouleri Little Forktail.

38 ♂ February 26, Adung Valley 28°10′ N., 98°40′ E., 6,000 ft.

Not uncommon; always seen by water running about on the stones like a wagtail. Usually on the smaller streams [C.].

There are specimens in the Museum from Nepal, Sikkim, Bhutan, Assam, the Miri and Dafla Hills and Tonkin but none from Northern Burma and the Shan States, where, according to the *Fauna*, it occurs.

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Phoenicurus frontalis Blue-fronted Redstart.

20 ♂ February 14, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft. 49 ♂ March 6, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Common [C.].

This species was found quite common in Yunnan by Rippon and Forrest where it apparently breeds since the latter collected a juvenile unable to fly.

After comparing Sikkim birds with those from Szechuan and Kansu I can see no difference and therefore Hartert's *P. frontalis sinae* becomes a synonym.

Rhyacornis fuliginosa fuliginosa Plumbeous Redstart.

29 ♂ February 20, 66 ♀ March 21, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Shot by the River. Very common, sitting on stones hawking flies like a flycatcher and spending a certain amount of its time on trees and bushes by the river bank. When other birds have gone to roost it is still active and at this time of the day has a habit of flying almost vertically up into the air some 15 or 20 ft., then swooping down on a large spiral to its original position. Kingdon Ward has seen one dive into the water when in flight, like a kingfisher [C.].

Harington found this species breeding in the Bhamo area.

Chaimarrornis leucocephalaus White-capped Redstart.

10 ? February 5, Adung Valley 25°20′ N., 97°45′ E., 5,000 ft.; 146 ? July 15, Adung Valley 28°20′ N., 97°40′ E., 13,000 ft.

10. Shot by river. Sits on stones in and by the river flicking its tail and hawking flies like a flycatcher. Periodically it runs under stones and occasionally flies up into trees and bushes on the river bank but not often. Fairly common, each pair seems to keep to its own stretch of water—six to eight hundred yards. White patch in the sunlight shows up like a piece of burnished tin. 146. Fairly common; seen on any stream up to 14,000 ft.

Grandala caelicolor florentes The Chinese Grandala.

Grandala caelicolor florentes Bangs, Proc. New Eng. Zool. Club., ix, p. 77 (1926)—Tachienlu.

16 ♂, 17 ♀ February 13, Adung Valley, 6,000 ft.

Both killed at one shot fired at a large flock sitting on the topmost branches of a high tree. Occasionally a dozen or so birds would leave the flock circle round swooping up and down, then return to the main body and settle again. Crops contained fruits and seeds of *Vaccinium* [C.].

This race was separated by Bangs on account of the smaller size and brighter blue colour of the male. In regard to the colour I find that this appears to be due to structural alteration to the feather caused by wear. A February and a May specimen from Sikkim cannot be distinguished from three males from Chuan chee obtained in May and June but January and December birds from the later locality are much darker. Hodgson's type is apparently a spring bird. The difference in size holds good.

6 ♂	*G. c. florentes*	131-136	10 ♂	*G. c. caelicolor*	146-150
4 ♀	,,	137-144	♀	,,	135-144

Calliope tschebaiewi Tibet Ruby-Throat.

135 ♂ July 2, 140 ♀, July 6, Adung Valley 28°20/ N., 97°45/ E., 12,000 ft.

135 shot in low rhododendron scrub above tree line. Rather fond of sitting on rocks above scrub level. 140. This bird is the mate of 135—they both have the same rather metallic call. On June 25, I saw this species in rhododendron scrub at 14,500 ft. [C.].

July 12. A young bird in full fledged but not able to fly very strongly, seen at 13,000 ft. I think, judging by the behaviour of some old birds near, it was the young of *C. tschebaiewi* [C.].

According to the *Fauna*, this species breeds in N. Burma and in winter is found throughout the Burmese hills. There are no specimens in the Museum from any locality in Burma.

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Tarsiger chrysæus chrysæus Golden Bush-Robin.

144 ♂ July 12, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.
Shot in forest; not very common [C.].
Harington records a specimen from the Bhamo District and it is not uncommon on the Yunnan Mountains.

Ianthia cyanura rufiliata Red-flanked Bush-Robin.

50 ♀ March 17, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.; 158 ♀ October 22, Adung Valley 28°15′ N., 97°45′ E., 10,000 ft.
50. Not very common; sits on low bushes hawking flies and hops about under them like a Robin. 158. Shot in forest, also seen at 12,000 ft. [C.]. These two birds do not differ from typical examples from Nepal and Sikkim. I cannot distinguish *I. practica* Bangs and Phillips from Loukouchai.

Turdus atrogularis Black-throated Thrush.

55 ♂ March 9, 63 ♂ March 13, 68 ♂ March 23, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.
No. 55 not seen before, No. 68 not common but occasionally seen; always alone [C.].
No. 55 crop full of big larvae, beetles etc.; No. 63 crop contained a whole snail, beetles, larvae etc. no seeds [K. W.].

Turdus ruficollis Red-throated Thrush.

57 ♂ March 31, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.
Shot in fairly open country. I have not noticed this bird before [C.]. Crop full of larvae, beetles etc. [K. W.].
This thrush has not been recorded from Burma before, the statement in the *Fauna* that it occurs in Northern Burma is probably based on two or three specimens in the Museum collected by Rippon in Yunnan, but wrongly labelled Kauri Kachin District.

Oreocincla dixoni Long-tailed Mountain-Thrush.

Turdus dixonii Seebohm Cat. Birds British Museum v. p. 161, 1881.
150 ♂ August 12, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.
Shot in forest; the first of this species I have noticed here, two days later I saw the same species in the scrub just above the tree line [C.].
In the *Fauna* this species is confused with *O. mollissima* and for the differences between the two see Ibis 1930, p. 579.
We have in the Museum specimens of this thrush as follows. Karen-nee vi (Ramsay), 2 Na Noi, S. Shan States, iii (Rippon), 2 S. Shan States (Thompson and Craddock), Chapa, Tonkin, xii (Delacour), 2 Lichiang Range, viii, x (Forrest), Chanting-Yangpi Road, Yunnan, viii (Rippon) Asalu, ii (Godwin Austen), Manipur (Hume), Darjeeling and Nepal (Hodgson).

Myiophoneus temminckii eugeniae Burmese Whistling Thrush.

157 ♂ October 21, Adung Valley 28°15′ N., 97°45′ E., 10,000 ft.
We have no specimens of this bird from N.-E. Burma, though over the border it is not uncommon in Yunnan. The correct spelling of the generic name of this bird is *Myiophoneus* and not *Myophonus* in spite of the note in the Corrigenda volume to the *Fauna*.

Prunella collaris ripponi Rippon's Accentor.

14 ♂ February 10, 42 ♂ March 3, 70 ♂ March 26, Adung Valley 28°10′ N., 97°40′ E., 8,000 ft.
No. 14 shot and brought in by a native. I had not noticed this bird although the native got it in the open country. Crop contained a good many small seeds including those of grasses. No. 42 brought in by a small boy. Not uncommon in open country and among low bushes. No. 70 one of a flock of about a dozen working about in open country and periodically flying all together for a short distance and then scattering and searching the dead grass and bracken, every now and again getting on top of a boulder to have a look round [C.].

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Prunella strophiata multistriata David's Accentor.

46 ♂ May 5, 59 ♂ May 12, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Not uncommon, habits like a robin hopping about under and amongst low bushes. A chattering alarm note [C.].

Originally described from Moupin, this accentor is not uncommon in N.-W. Yunnan, but has not before been noted so far west previously.

Prunella immaculata Maroon-backed Accentor.

12 ♂ February 9, 344 ♀ February 22, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Goes about in small parties in fairly open country searching under leaves and in low bushes; fairly common [C.].

This accentor ranges from Nepal eastward along the Himalaya to Szechuan and south to Yunnan—the Mekong-Salween Divide etc. It has not been previously recorded from Burma.

Hemichelidon sibirica rothschildi Yunnan Sooty Flycatcher.

148 ♂ July 22, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.

Shot in the forest, not uncommon [C.].

This race was described from birds collected by Forrest in the Tengyueh District and the Lichiang Range. The specimen from the Shan States—presumably the bird collected by Rippon East of Stedman, S. Shan States but no details are given—mentioned by Baker in the *Fauna* as belonging to this race appears to me to be indistinguishable from Himalayan examples. Bailey however shot a male at Sangachu Dzong, S.-E. Tibet in June.

Siphia strophiata strophiata Orange-gorgeted Flycatcher.

97 ♂ April 22, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Not seen before during this month. Flight and habits like a Robin [C.].

Forrest and Rippon collected numerous specimens in Yunnan and Anderson obtained a male at Ponsee while Harington shot a single example in the Bhamo District.

Muscicapula sapphira Sapphire-headed Flycatcher.

97 ♂ April 22, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Shot in fairly open country, not seen before [C.].

Anderson got a specimen in April at Ponsee and Forrest several examples in the Salwin Valley latitude 25°20′ N. Three Burmese birds in the Museum do not differ from typical Nepal and Sikkim skins though they run larger.

7 ♂ Sikkim and Naga Hills 59-62.5 mm.
3 ♂ Salwin and Adung Valley and S. Shan States. 63-64 mm.

Eumyias thalassina thalassina Verditer Flycatcher.

81 ♂ April 8, 88 ♂ April 13, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Not seen before April 8, but fairly common afterwards [C.].

True *Eumyias thalassina thalassina* (olim *Stoparola melanops*) is found from Nepal and Sikkim through Assam, Burma, part of Assam down to S. Annam, and has no black line at the base of the bill, whereas in 90 per cent. of the birds from the Malay Peninsula and Borneo it is present. In addition these southern birds are smaller.

	Wing.
8 ♂ Malay Peninsula	71-77 mm.
2 ♂ Borneo	75-77 mm.
4 ♂ S. Annam	85-88 mm.
5 ♂ S. Shan States and Karanee	86-89 mm.
7 ♂ Sikkim	81-87 mm.

Culicicapa ceylonensis ceylonensis Grey-headed Flycatcher.

102 ♀ May 3, 1931 Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Fairly common, but not seen until about ten days ago [C.].

Harington found this flycatcher common at Bhamo.

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Chelidorhynx hypoxantha Yellow-bellied Flycatcher.

127 ? June 21, 132 ♂ June 27, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft. Also seen in September in Tibet 28°25′ N., 97°55′ E. [C.].

Breeds commonly in the Bhamo district according to Harington and Forrest found it common in Yunnan.

Pericrocotus brevirostris affinis Assam Short-billed Minivet.

109 ♂ May 16, Adung Valley 20°15′ N., 97°40′ E., 7,500 ft.

Killed by a coolie with a stone [C.] 10 April, saw a flock of six scarlet minivets today [K. W.].

The single male minivet listed above, two males collected by Rippon in the Kauri Kachin District and one by Anderson on the Taping R., Kakhyen Hills agree with birds from Assam and Sikkim. Unfortunately we have no good skins of females from the first two localities to compare with topotypical *P. b. affinus*, but they are sufficient to show that they are not *P. b. styani* Baker (Szechuan), if indeed that race can be distinguished from *P. b. ethelogus* Thayer and Bangs (Hupeh). Four females from Mt. Victoria are very rich yellow below and grey on the back, wanting the greenish tinge in Assam birds. A Manipur female is much the same and so too is one from Taungyi, S. Shan States while another from 'S. Shan States' (Rippon) does not differ from the Assam examples. A single female from Fort Stedman (Rippon) is paler on the back than typical *affinis* but with the same greenish yellow rump to the female of Baker's *P. b. ripponi*, the supposed male of which was collected by Rippon at the same time and place. This 'male' is not sexed and there is no evidence to show that it is a male—indeed I should say it was a female abnormally coloured. It differs from the normal female in the darker back and on the yellow replaced by reddish orange. From the normal male it differs in not having a black throat, no black on the upper surface and the scarlet replaced by reddish orange. Furthermore it has a reddish orange band on the forehead which is not found in any minivet. There is a very similar bird, rather more orange, also collected by Rippon, from the Kauri Kachin District in July 1901. These birds are indeed very similar to some of the females of *P. b. annamensis* Robinson and Kloss from Dalat, S. Annam.

Pericrocotus solaris solaris Yellow-throated Minivet.

9 ♂ January 31, Nam Tamai Valley N.-E. Burma, 4,000 ft.

Spiders and beetles in crop [C.].

Dicrurus leucophæus hopwoodi Assam Grey Drongo.

95 ♂ April 19, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Habits like any drongo, sits on the bare branch of a high tree hawking flies etc. Very wary, I have been trying to get one for the last two months. Not uncommon; there seems to be more about this last month [C.].

Tribura thoracica thoracica Spotted Bush-Warbler.

134 ♂ July 3, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.

Shot in low scrub jungle above tree line, common [C.].

Godwin-Austen obtained this species in Sylhet and apparently it has not been found further east within Indian limits, though in Yunnan Forrest collected specimens on the Mekong-Salwin Divide and the Lichiang Range.

Phylloscopus pulcher pulcher Nepal Orange-barred Willow-Warbler.

136 ♀ July 3, 1931, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.

Shot in jungle, very common [C.].

Phylloscopus magnirostris Large-billed Willow-Warbler.

120 ♂ June 4, Adung Valley 28°20′ N., 97°40′ E., 9,000 ft.

Common [C.].

Phylloscopus inornatus inornatus Crowned Willow-Warbler.

84 ♂ April 10, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.; 149 ♀ August 10, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.

Anderson collected specimens at Bhamo and Ponsee.

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Abroscopus schisticeps ripponi Sharp's Flycatcher Warbler.

54 ♀ March 8, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Shot with a crossbow, common, goes about in flocks methodically searching bushes, sometimes going up trees, particularly those covered with creepers, then flying down together one after the other like a lot of falling leaves, make a continual chattering [C.].

Rippon and Forrest found this bird common in N.-W. Yunnan.

Perissospiza icteroides affinis Allied Grosbeak.

139 ♀ juv. June 28, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.

One of a pair; the other presumably the male had a very attractive golden yellow breast—both made rather a pleasant bell-like call [C.].

July 13. Watched one hopping about on the grass under bushes, picking up seeds. It was quite close to me and did not appear afraid [K. W.].

Not recorded from Burma before, though Forrest and Rock found it not uncommon on the Lichiang Range and Bailey obtained a male on June 19, 1911, at La Gyap 13,500 ft., E.-E. Tibet latitude 28°50′ N., longitude 98° E.

Perissospiza carnipes carnipes White-winged Grosbeak.

151 ♀, 151a ♀ juv., August 14, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.

Eats the blue *Gaultheria* berries [K. W.]

According to the *Fauna* this Grosbeak is not known further east than 'the hills north of the Brahmaputra in Assam'. Both Rippon, Forrest and Rock met with it in N.-W. Yunnan.

Pyrrhula erythaca Beavan's Bullfinch.

123 ♂ June 13, 138 ♂, July 8, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.

Shot in Abies forest; June 23, four seen [K. W.]. Not uncommon [C.].

It is very doubtful whether *P. e. altera* Rippon—Yunnan—can be kept distinct from *P. erythaca erythaca*—Sikkim—since the only difference in colour appears to be that in Sikkim males the red on the breast is suffused with yellow, while in birds from Yunnan the yellowish tinge is wanting. In size Yunnan birds run rather larger 8 ♂ 82-87 mm. as against 7 ♂ from Sikkim 80-84.5 mm. We have no females of the typical form and I have not been able to hear of one in any collection. According to the *Fauna* Bullfinches of this type have been seen in the N. Shan States.

Pyrrhula nepalensis ricketti Rickett's Bullfinch.

Pyrrhula ricketti La Touche Bull. B.O.C., xvi, p. 21 (1905)—Mts. of N.-W. Fokien.

93 ♀, 94 ♂, April 18, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

A pair not seen before [C.].

These two specimens agree with a series from Fokien. Forrest obtained examples in N.-W. Yunnan. This race is distinguished from *P. n. victoriae* by the darker colour of the back and more scaly appearance of the feathers of the head. It is new to Burma.

Carpodacus erythrinus roseatus Common Indian Rose-Finch.

106 ♂ May 13, Adung Valley 28°10′ N., 97°40′ E., 7,500 ft.

Not uncommon, shot with a crossbow [C.].

Spinus tibetanus Tibetan Siskin.

51 ♂, 52?, 53 ♀, March 8, Adung Valley 28°20′ N., 97°40′ E., 6,600 ft.

Shot out of a flock of about forty or fifty wheeling about not very high up. I killed a fourth—a female—but it was too badly shot to preserve. Crops full of small seeds and quartz grains. I have not noticed this bird before [C.].

The Tibetan Siskin, originally described from the borders of Sikkim and Tibet, was for long only known from that area. In 1926 Lord Rothschild recorded in the Novitates Zoological, xxxiii, p. 332, a male from the Lichiang Range, Yunnan, collected by Forrest and in 1931 Dr. Rock obtained a pair on Gyi-na-loko in the autumn.

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In the *Fauna* it is stated that Whymper's and Ward's collectors procured a nest in Ladak, but the species is not included in Colonel Ward's list of birds of Kashmir and I think there must be some mistake. Moreover Ladak has been carefully worked by a number of Ornithologists within recent years and no one seems to have met with it. As pine forests do not exist in Ladak it is most unlikely that a bird like a Siskin would be found there.

Passer rutilans intensior Yunnan Cinnamon Sparrow.

60 ♀, 61 ♂, 62 ♂, March 13, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft. Shot just before sundown as the flock was going to roost in a high leafy tree. They were behaving much the same and making a similar noise as sparrows going to roost at home. Occasionally the whole flock—about 15-20 birds—would leave the tree, circle round once or twice and then go back and sit chattering and moving about on the tree once more. I have not noticed this bird before [C.].

Fringillauda nemoricola nemoricola Hodgson's Mountain Finch.

30 ♀, 31 ♂, February, 43 ♂ March 3, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

No. 30. One of a flock of about twenty feeding on cultivated land lying fallow. While feeding the whole flock would rise together, wheel round in the air once or twice and again go down on the ground or settle in a tree for a time. This and No. 31 were both got with one shot but unfortunately No. 43 only had a wing broken. It fluttered away along the ground with the remainder of the flock flying round and swooping down on it just as rooks and jackdaws will do when one of their number is wounded. I have not seen this bird before. No. 43 brought in by a native. Not uncommon in open country and cultivated land; always seen in flocks. Crop full of seeds [C.].

Not recorded from Burma before, though it occurs in Yunnan, on the Lichiang Range (Forrest).

Emberiza pusilla Little Bunting.

19 ♂ February 13, 40 ♀ March 1, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

No. 19 brought in by a native, crop full of seed; No. 40 fairly common on cultivated land and open country [C.].

Stanford obtained two females at Hopin in the plains of the Myitkyina District in 1932.

Motacilla alba leucopsis White-faced Wagtail.

67 ♂ March 23, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Two seen together. I have seen no others nor noticed this wagtail before [C.]. Harington mentions this bird as occurring in the Bhamo District.

Motacilla cinerea caspica Eastern Grey Wagtail.

96 ♂ April 22, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Not seen before [C.].

Motacilla citreola calcarata Hodgson's Yellow-headed Wagtail.

100 ♂ May 1, 101 ♀ May 2, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

No. 100. One of a flock shot in open. First seen about a week ago. N. 101. One of a pair, the other similar to No. 100 [C.].

Anthus hodgsoni Indian Tree Pipit.

13 ♂ February 9, 27, 28 ♂ February 19, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Very common on the flat open bracken covered valley bottom. Crop full of seeds [C.].

Anthus roseatus Hodgson's Pipit.

128 ♂ June 23, Adung Valley 28°20′ N., 97°45′ E., 12,000 ft.; 147 [♀] July 21, Adung Valley 28°20′ N., 97°40′ E., 12,000 ft.

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Shot in open meadow above tree line, seems fairly common [C.].

According to the *Fauna* this bird is said to occur in the Northern Shan States but there are no specimens in the Museum from anywhere in Burma.

Æthopyga ignicauda exultans Yunnan Fire-tailed Sunbird.

129 ♂ June 25, Adung Valley 28°20′ N., 97°45′ E., 13,000 ft.

Very common amongst the scrub rhododendron, juniper etc. above the tree limit. I have not actually seen it in the forest yet [C.].

This race of the Fire-tailed Sunbird was included in the *Fauna*, although it had not actually been recorded from within the limits dealt with. There is however a female in the Museum collection obtained by Rippon in the Kauri Kachin District. It is rather dark in colour, as are many of that collector's specimens, owing to his methods of drying! Salvadori recorded *ignicauda* from Bhamo.

Five birds from Yunnan in the British Museum were separated from the typical race by Stuart Baker as *A. i. exultans* on account of the deeper crimson of the upper side, deeper yellow below, greater extent of red on the breast and larger bills. A male from Kumaon and two from Nepal are certainly paler than the Yunnan birds, but in over eighteen from Sikkim and Assam a few are the same as the Nepal birds while the majority are darker and resemble very closely the Yunnan specimens, indeed, if these last were better prepared I doubt much whether they could be distinguished from them. In the yellow colour of the underside I can see no difference and in three out of the five Yunnan specimens the red on the breast is in no way different to Sikkim examples, but in the remaining two, the type and another, the red on the breast is brighter and of greater extent. The bills according to Baker measure *A. i. ignicauda* 17-19 mm, *A. i. exultans* 19-21 mm., but I find there is no difference my measurements being 17.5-19.5 mm. and 18-19.5 mm. respectively.

Æthopyga dabryii Dabry's Sunbird.

72 ♂ March 27, 91 ♂ April 16, Adung Valley 28°10′ N., 97°40′ E.

Not so common as *Æ. nepalensis nepalensis* [C.].

Æthopyga nipalensis nipalensis Nepal Yellow-backed Sunbird.

11 ♂ February 6, 18 ♀ February 13, 35 ♂ February 24, 69 ♂ March 23, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Very common. No. 69 shot with a crossbow. These little birds are very common and equally confiding, so are a ready prey for small boys with a crossbow [C.].

March 22. Saw Sunbird visiting *Rhododendron stenaulus* [K. W.].

Hypopicus hyperythrus sikkimensis Eastern Rufous-bellied Woodpecker.

108 ♂ May 16, 116 ♀ May 29, 119 [♀] June 2, Adung Valley 28°15′ N., 97°40′ E., 7,500-8,000 ft.; 155 ♂ October 11, Adung Valley 28°15′ N., 97°40′ E., 6,000 ft.

In the *Fauna* this Woodpecker is not recorded further south in Burma than the Kachin Hills but there are in the British Museum specimens from Maymyo (Harington), Kalaw (Craddock, Thompson, Oates and Venning), Tonghoo (Hargett collection) and S.-W. Yunnan (Wingate). In addition it has been recorded from Mt. Victoria by Wood, the Chin Hills by Hopwood and Mackenzie and various localities in the S. Shan States by Bingham and Cook.

Dryobates cathpharius tenebrosus Yunnan Red-breasted Pied Woodpecker.

Dryobates cathpharius tenebrosus Rothschild Nov. Zool. 1926, xxxiii, p. 240—Shweli-Salwin Divide.

21 ♀ February 16, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.

Habits are much more like a Tree Creeper, flying from dead tree to dead tree and searching each one methodically. The call is loud for the size of the bird and is a rather monotonous chip, uttered at intervals when searching a tree and rather more quickly when flying. Not uncommon, I have seen three or four during the last ten days [C.].

This single specimen belongs to the race described by Lord Rothschild from Yunnan which 'differs from *D. cathpharius* in the less yellowish, more greyish

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underside, which is much more heavily spotted with black'. From *D. c. pernayi* Verreaux (Rev. et Mag. Zool. 1867, p. 271) from Kansu this race is distinguished by the smaller size and lesser amount of black on the breast and malar streaks, while compared with *D. c. pyrrhothorax* Hume (Manipur and Naga Hills) it has a greater amount of black on the underside and also is larger. In addition to the female listed above we have two males collected by Forrest on his last expedition in Yunnan, a male from the Yangtze big Bend (Rippon) and others from Na Noi, Loi Maw and the hills east of Fort Stedman in the S. Shan States (Craddock and Rippon).

Measurements:—

		Wing.	Bill from base of skull.		Wing.	Bill.
D. c. cathpharius	4 ♂	100-102	18.5-20	4 ♀	97-102	17.5-20
D. c. pyrrhothorax	4 ♂	97-99	18.5-20	1 ♀	97	18.5
D. c. tenebrosus	5 ♂	97.5-104	19-21.5	4 ♀	99-104	18.5-20
D. c. pernyi		111-112	20.5	—	—	—

Dryobates darjellensis Darjeeling Pied Woodpecker.

114 ♀ May 27, Adung Valley 28°15′ N., 97°40′ E., 8,000 ft.
Shot in jungle, not uncommon [C.].
This Woodpecker in the *Fauna* is stated to be found in Burma—the Chin and Kachin Hills, and Shan States. It is however not represented in the Museum from the Shan States or Kachin Hills and I cannot find any record of its occurrence there, though we have specimens from Tonghoo.

Sasia ochracea ochracea The Indian Rufous Piculet.

2 ? December 2, 1930, Kadrangyang, 70 miles N. of Myitkyina, 2,000 ft.
Habits like any woodpecker tapping slowly and then tearing off slivers with its beak. Mainly seen on dead bamboo and tall grasses—common [C.].
This single example belongs to the typical race, which is found from Nepal to Suddya and south to the Kauri Kachin District, whence Rippon obtained an example. Harington records it nesting in the Bhamo District. *S. o. querulivox* Baker, Assam S. of the Brahmapootra, Naga Hills, Manipur, Lower Chindwin and S. Shan States, is intermediate between the typical race and *S. o. reichenowi* Hesse a pale bird found in Tenasserim—as far south as the Paksehan estuary—Tounghoo and S. Annam.
Some examples of *S. o. querulivox* are very pale, indeed four skins in the museum from the Khasia Hills are barely separable from Tenasserim specimens.

Cuculus poliocephalus poliocephalus Small Cuckoo.

107 ♂ May 14, Adung Valley 28°10′ N., 97°40′ E., 7,500 ft.
I heard this bird for some weeks, but have not been able to see it before. It has a particularly maddening and monotonous call, rather like the expostulations of a very young hen with a treble voice, which has just escaped being run over by a car, repeated at short intervals for hours! [C.].
Rippon obtained a specimen in the Kauri Kachin District in July and Harington lists it as occurring in the Bhamo District. Probably this cuckoo breeds in the N.-W. Yunnan mountains as Forrest collected examples between May and August on the Lichiang Range and the Tenguyeh Valley.

Upupa epops longirostris Burmese Hoopoe.

87? April, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.
Only seen during the last few days and then only twice [C.].

Pyrotrogon erythrocephalus erythrocephalus Red-headed Trogon.

5 ♂ January 9, Nam Taimai 4,000 ft.
Fairly common [C.].

Collocalia brevirostris pellos Szechewan Swiftlet.

Collocalia inopina pellos Thayer and Bangs, Mem. Mus. Comp. Zool. Harvard., xl, p. 158 (1912)—Waschan, Szechuan.
65? March 15, Adung Valley 28°10′ N., 97°40′ E., 8,000 ft.
February 25. Swifts seen tonight for the first time; 28 February seen again just before sundown; 14 March. Seen flying very high tonight. No. 65.

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This is the bird referred to above as 'swift'—a great number seen today—15 March—all flying low. Also in Tibet 28°25′ N., 97°55′ E., September.

We have in the Museum only four specimens of this bird—in addition to the above specimen in the Museum as follows: Tonkin (Stevens) recorded by me as *C. inominator* (!); adult and juvenile Omi-hsien, S. Szechuan (M. P. Anderson) and an adult (labelled juvenile) from the Mekong-Salwin Divide (Forrest), which was recorded as *C. f. brevirostris* by Lord Rothschild. To the west this race of swiftlet is replaced by *C. b. brevirostris*, which ranges from Eastern Assam and Manipur to Dalhousie, and differs in its smaller size.

Glaucidium cuculoides rufescens Burmese Barred Owlet.

160 ? November 29, 1931, Nam Tamai.

Trapped and brought in by natives [C.].

Ducula badia griseicapilla Grey-headed Imperial Pigeon.

Ducula badia griseicapilla.

3 ♂ December 11, 1930, Kachin Hills, 150 miles N. of Myitkyina.

Recorded by Harington from Bhamo District. Apparently this pigeon does not extend into Northern Yunnan as neither Forrest nor Rippon collected specimens, though Wingate obtained a single male at S.-W. Yunnan.

Columba leuconota gradaria Hartert, Eastern Snow Pigeon.

131 ♀ June 25, Adung Valley 28°20′ N., 97°45′ E., 14,000 ft.; 141-2 ♀ July 8, Adung Valley 97°40′ E., 13,000 ft.

No. 131 one of a pair, the other of which flew away and settled on a stone slide, where its colouration, which was rather conspicuous on the grass, merged perfectly with the background.

July 8. Climbed to about 15,000 ft. and saw several pigeons similar to No. 131 and by a really fine effort succeeded in killing three out of a flock of six at one shot. Both this flock and two others, which I saw were, feeding on open screes between 13 and 15,000 ft. July 9. Another flock of pigeons, similar to those seen yesterday, seen at about 14,000 ft. These pigeons are almost always seen on stony screes feeding, though occasionally they are to be seen on the grass when they are very conspicuous. In flight their white bodies show up in marked contrast to their dark wings [C.]. No. 131. Crop full of small bulbils of the pink *Polygonum* and a few seeds of *Morina* [K. W.].

This pigeon has not previously been recorded from Burma and Forrest sent no specimens from Yunnan, though further north it occurs in that country on the Yangtse, where Dr. Rock obtained examples, which according to Riley (P.U.S.N.M. 80, p. 15, 1931) are somewhat intermediate in colour between *C. l. leuconota* and *C. l. gradaria* Hartert from Szechuan.

Gennæus horsfieldi horsfieldi Black-breasted Kalij.

4 ♂ December 23, 1930, Hkampti Plains, Upper Burma, 1,500 ft.

This and a companion were seen together at close range and both seemed identical. They walked about making a low clucking noise.

Rippon and others obtained this pheasant in the Bhamo District where it appears to be not uncommon.

Lophophorus sclateri Sclater's Monal.

153, 154 ♀ juv. August 19, Adung Valley 28°20′ N., 97°45′ E., 13,000 ft.

August 17, Monal heard calling at 13,000 ft. amongst scrub and cliffs above the tree limit. I could not see them because of the mist and rain, though they sounded quite near. August 19, high up above the tree line I saw a flock of monal and after a difficult stalk managed to get within range and shot two. One bird in the flock (the cock ?) was much bigger than the two I shot and had the blue round the eye more pronounced, but otherwise appeared very similar. These birds seem to keep very much to the same locality: during the two months we have been here I have found two places where these birds live and never have been there without either seeing or hearing them. They are very cunning, one of the flock always seems to be on guard on some ridge or prominent mound and gives away their position by uttering the rather harsh alarm call (rather like a mixture between that of a peacock and a guinea fowl), otherwise they would probably escape unobserved as their colouration

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harmonizes admirably with their haunts among the dwarf rhododendron, juniper, cotoneaster, grass etc. Nos. 153-154 contained *Polygonum* seeds and heads of some thistle or hard-headed flower in their crops [C.].

July 10. Saw a pair of Monal and then saw and heard six or eight higher up on the grey scree. Two sentinels stood on rocks uttering their shrill, rather plaintive alarm call, a single cry repeated again and again while the others strutted up the scree together.

Baker does not give this Monal as occurring in Burma, though in the donation list of the Society, vol. xxiii, p. 592, there is a record that Mr. F. C. Lowis presented three from the Burmo-Chinese frontier. These came from the Htawgaw Hills, between the Kachin Hills and Yunnan, in the cold weather of 1914 and Capt. Kingdon Ward has recorded it from Imam Bum in the same Hills (*Journal* 1921, xxvii, p. 756). Later in 1925 the late Capt. West shot two males near Myitkyina in October which are now in the National Collection. Capt. Kingdon Ward, on his 1924 plant collecting expedition down the Tsangpo, obtained a male in juvenile plumage and an adult female at the Po-Tsango and Tsangpo confluence at 9,000 ft. on February 14. Lord Rothschild records (Nov. Zool. 1926, p. 211) that Forrest obtained a young male which he says 'is so far unique' but does not give any description of it and I therefore add one of Capt. Kingdon Ward's bird. Differs from the adult female in the darker colour of the mantle, the paler, more white, colour of the lower back, rump and upper tail coverts and in the greater amount of cinamon on the tail feathers, which colour is entirely absent from the adult from the Tsangpo, but present in slight frecklings in a bird from the Mishmi country and figured in P.Z.S. 1879, pl. li. The upper side of the young male is narrowly barred with faint cinamon bands instead of frecklings. On the breast and neck the black feathers of the adult are beginning to appear and a few metallic feathers to show on the head.

Tragopan temminckii Temminck's Tragopan.

82 ♂ June 7, Adung Valley 28°10′ N., 97°40′ E., 7,000 ft.

Bill black; feet flesh; iris slate; round eye, throat and harns bright cobalt blue.

Brought in by a native trapped in the jungle [C.]

According to Oates (*J.B.N.H.S.*, xix, p. 260) Lt. C. M. Macmillan shot a male of this Tragopan in 1903 at Sadon, due East of Myitkyina at an elevation of about 9,000 ft., and in March 1904 Mr. W. Scott shot two examples on the Pansing Pass near the same place. In the cold weather of 1914 Mr. F. C. Lowis obtained a male near Htawgaw, while we have in the British Museum a pair procured by Major Burd in the Myitkyina District in October 1925, and another got by Capt. West near Hipmaw in October 1925 and it appears therefore that this Tragopan is not uncommon in N.-E. Burma. In addition to the specimens obtained by Co. F. M. Bailey in the Mishmi country and S. Tibet (Op. cit., vol. xxiv, p. 76) it should be mentioned that Capt. Kingdon Ward collected a young male on December 16, 1924, at the confluence of the Po-Tsangpo and Tsangpo in S.-E. Tibet.

All the western examples of this Tragopan I have examined are rather darker below and of a less brick red than Chinese birds and in size tend to run larger, wing 243, 254, 260, 263 mm. as against 230-253 in fourteen Yunnan and Sze-chuan birds.

Tragopan temminckii was first made known to science by Dr. J. E. Gray in the *Illustrations of Indian Zoology*, vol. i, plate 50 (December 2, 1831) and the bird from which the drawing was made was presented along with a second male to the British Museum by J. R. Reeves. Gould (*Birds of Asia*, vol. vii, pl. 47) tells us that Reeves first saw this species in the aviary of a Mr. Beal in Macao and 'did not rest until he had sent specimens to the National Collection'. On May 13, 1834 Dr. G. Bennett exhibited before a meeting of the Zoological Society a drawing of one of Mr. Beal's birds and stated that they came from 'the province of Yunnan bordering on Tibet', adding that Mr. Beal had not been able to obtain any female specimens.

Ithaginis cruentus kuseri Yunnan Blood-Pheasant.

74 ♀ March 31, Adung Valley 28°10′ N., 97°40′ E., 8,000 ft.; 126 ♂ April 20, 142, 145 ♂. ♀ July 10, Adung Valley 28°45′ N., 97°45′ E., 12,000 ft.

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No. 74 shot sitting on a pile of logs. No. 142 shot in forest, alarm call like a hen common pheasant. One of a pair, the other ran about mewing for some time, but I could not see it. July 10. I saw two pairs of Blood pheasants, each pair walking about together with a well grown family. The young were, I should say, at least six weeks old and were in the forest at about 13,000 ft. August 19. Today came across a family party of Blood pheasants. Shot the cock and a young hen, the latter the size of a French partridge. The party consisted of six or seven and I had to follow them through the forest before I could get a second. All the time they kept 30-40 yards away and continually uttered their alarm call, though occasionally they would stop to pick up food [C.].

July 27. Alpine Valley. In the forest I saw a pair of Blood pheasants. The female has a crest and strutted about, with tail outspread bobbing her head abruptly to pick up food as she walked, then throwing it up suddenly and all the time she uttered a single rather querulous cry. The male has the same upright way of pecking at the ground and looking up quickly. His tail however was not spread. October 4. In forest below ridge (area 19,000 ft.) I saw a whole party of Blood pheasants—at least eight—they were certainly two cocks. The cock gives a shrill cry of alarm, runs a short distance, then stops, the rest of the covey also. As often as not they stand on an eminence and look at you from some twenty to thirty yards away. They seem to be bewildered and run hither and thither, but never go far. The cock struts and runs with his tail outspread. On October 30 a large family of Blood pheasants visited the camp and five were shot, but the remainder took very little notice and were scarcely alarmed, continuing to squawk and run this way and that [K. W.].

In the *Fauna*, this Blood Pheasant is said 'to inhabit Yunnan on the Shweli-Salwin Divide; extending west to Mishmi and Abor Hills and north and east of the Dihong and Brahmapootra rivers.' We have in the British Museum the following specimens: ♂ Tsekou, Yunnan (P. R. Soulce); Tenguyeh, Yunnan (E. B. Howell); ♀ (2 ♂ also obtained) near Htawgaw Hills, between Kachin Hills and Yunnan cold weather 1914 (F. C. Lowis) 4 ♂, 1 ♀ Hipmau, Myitkyina District October 1925 (West); 2 ♂, 1 ♀ Seinghku Valley 10,000 ft., 28°8′ N., 97°24′ E., May, June and October, 1926 (F. Kingdon Ward); 6 ♂, ♀, Tsu R., Mishmi Hills and Sumdo, S. Tibet (F. M. Bailey).

Two males of *I. c. clarkei* collected by Forrest on the Lichiang Range approach *I. c. kuseri* and have the throat and breast washed buff, intermingled with numerous red feathers. I have followed Lord Rothschild in considering all the Blood Pheasants as races of *I. cruentus* Hardwick from Nepal.

Tringa hypoleucos Common Sandpiper.

1 ? November 30, 1930, Tiang Zup 50 miles N. of Myitkyina.
Seen on several occasions.

Phalacrocorax carbo sinensis Chinese Cormorant.

80 ♀ April 7, Adung Valley 28°10′ N., 97°41′ E., 6,000 ft.
Shot sitting on a log in the river and seen fairly often during the last three weeks, but not before. Unexpectedly good eating! Several more also seen [C.].

Anas crecca crecca Common Teal.

39 ♀ February 27, Adung Valley 28°10′ N., 97°40′ E., 6,000 ft.
Shot at dusk in a small muddy backwater off the Mai river. I have not seen this duck before [C.].

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THE LIFE-HISTORY OF THE SPIDER (*MYRMARACHNE PLATALEOIDES*) (CAMBR).

A mimic of the Indian Red Ant.

BY

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(*With one plate*).

The Spider *Myrmarachne plataleoides* is a common mimic of the Red Ant, *Oecophylla smaragdina* which may be seen almost anywhere in this country. The mimicry is so perfect that quite often it requires the second glance of even an experienced collector to distinguish one of these spiders from the ants amongst whom they are often seen moving about. Mimicry of ants by spiders is supposed to bestow on them certain advantages. In some cases the mimicry is suggested to be aggressive; under the false garb of an ant, the spider is supposed to be enabled to approach the ants without raising their suspicions, and thus feed on them with impunity. This, however, need not be considered here since this spider does not appear to feed on its models.

In certain others, of which the present is an instance, the mimicry is supposed to be protective; the ants being ferocious are generally left alone by insectivorous animals and the spiders by imitating them and living near them might share their immunity.

The Red Ants are certainly ferocious, but the protective value of a spider imitating this ant is questioned on many grounds. It is pointed out that the *Oecophylla* is not so immune from the attacks of insectivorous animals as is generally believed to be; there are certain birds and other animals which do feed on them. C. W. Mason in his "*Food of Birds in India*" speaks about ants:— "The ants like the grasshoppers are exceedingly abundant insects and form a very large proportion of the insect food of birds in India. They are perhaps the favourite food of the Woodpeckers. Wrynecks, Rollers and some of the pheasants. Most birds that eat insects of any kind will almost certainly be found to take ants of one species or other." In view of this it is useless merely to assert that ants as a class are left alone by insectivorous animals and that hence ant mimicry would be of high protective value to the spider. Then, what advantage does this spider have by going out of its way to imitate the ant?

That this mimicry is of some protective value I am convinced; but the usual way of explaining the protective significance is faulty, for it is based on the assertion that ants are rarely taken by insectivorous animals. A closer study of the habits and behaviour of these organisms, however, reveals certain facts hitherto ignored, but which seem to me, to afford a satisfactory explanation of this phenomenon.

In the first place, we have to remember that the ants are so numerous and that the spiders moving about amongst them so few and scattered that the chance of the spiders for escape even

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under the worst conditions is very great. The vast majority of the victims would naturally be from the major species, the scattered individuals very often being ignored or missed.

But a far more important factor may be recognised in the different modes of behaviour of the ants and the spiders when confronted by danger. When an intruder is sighted the ants rush forward; they never slink away and so they easily fall a prey to such animals as possess the power to resist their attacks and feed on them. But the *Myrmarachne* which may be moving about on an adjoining leaf or twig, as soon as it sees the possibility of danger, the approach of any stranger, it by a sudden movement hides under cover of a leaf. The prey-hunter loses its prey; but it never has to search for the hidden quarry. All around run the Red Ants, which boldly, in their characteristic aggressive manner, hasten to the intruder which can, to the best of its ability, feed on them. That this fact has hitherto been overlooked is nothing to be wondered at when we remember that much of our knowledge of ant-mimics comes from preserved collections, there being only scanty notes on their real behaviour and habits from field observers. *Thus we see that by ant-mimicry the Myrmarachne has lessened its probable persecutors to a great extent, the common enemies of spiders more or less leaving it free. Even from the ant-feeding forms, it gains comparative safety due to its shy nature and quicker movements as contrasted with the bold and assertive behaviour of the ants.*

Ant mimicry is certainly of considerable protective value to the spider. Perhaps, it is a consequence of this protection that the fertility in this spider is rather low. This low fertility in ant-mimicking spiders is usually regarded as an indirect proof of the protective value of ant-mimicry. It is pointed out that whilst spiders as a group are highly prolific, laying several hundreds of eggs at a time, these mimicking spiders lay only a few eggs. *Myrmarachne plataleoides* lays only 15-20 eggs at a time. In certain other kinds of ant-mimicking spiders the reduction of the number of eggs laid has gone still further; for, some of them appear to lay only three or even two eggs at a time!

While the reduction of the fertility of the ant-mimicking spiders is very significant and lends strong indirect evidence to the protective value of mimicry, it should be noted that the comparison of this with the prolificity of the *Epeiridae* gives rather an exaggerated idea of this reduction. The *Attidae* generally lay only a small number of eggs compared with the *Epeiridae*. The ordinary Attid spiders which are no ant-mimics lay only about 20-30 eggs in a cocoon. It is with these that the productivity of the Attid ant-mimics should be properly compared.

Here, however, a puzzling question confronts us. *M. plataleoides* mimicking the Red-Ant is protected and in the light of this, its low fertility is intelligible. But we also know that destruction among young spiders is very great and so if these few young ones are not protected in some way they would not be able to maintain their numerical strength. Protection during one stage in life alone will not be efficient. If the spider is protected only

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Fig 1

Fig 2

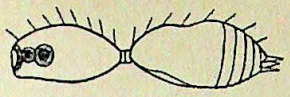

Fig 3

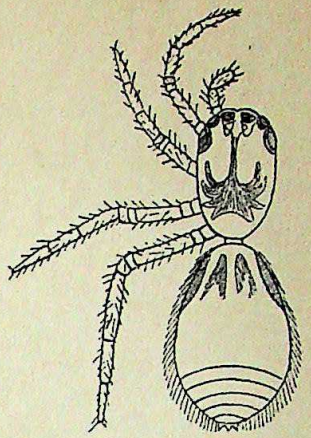

Fig 4

Fig 5

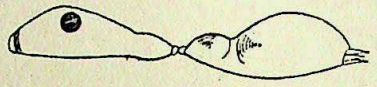

Fig 6

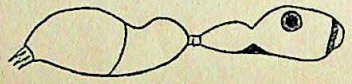

Fig 7

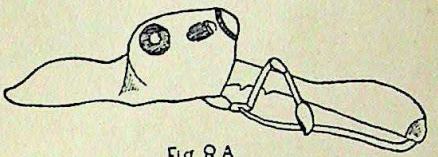

Fig 8 A

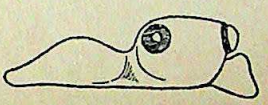

Fig 8 B

LIFE-HISTORY OF *Myrmarachne plataleoides* (Cambr.). (For explanation of figures see end of article).

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during its adult stage while the other stages during which destruction seems to be very high, are left unprotected, the survival of the species with low fertility would be a serious problem. This difficulty has been already pointed out by McCook with regard to *Synageles picata*, an American Ant-mimicking spider which lays only three eggs! As far as I am aware no proper solution to this has, as yet, been offered.

Are the earlier stages of this spider unprotected or, do they have some means of protection? If so, how are they protected? To understand this I made a study of the life-history of the spider *M. plataleoides*. It revealed many interesting facts; a brief account of this as I observed during the last three years is given below.

The spider as has been mentioned above, lays about 15-20 eggs at a time, which are enclosed in a cocoon or nest constructed on a leaf. Over this cocoon a silken canopy is spun beneath which the spider-mother remains guarding the eggs while they are being hatched.

In a week's time the eggs appear to hatch. The egg-membrane splits and the embryo escapes from it. The limbs are formed but are glued to the body and the curious little animal is incapable of movement. The front part of the body is translucent while the hinder portion is yellowish and rounded with stored yolk. In this condition it remains only for a very short period for, in two days it undergoes the first moult while still within the cocoon (Fig. 1).

The Spiderling (Fig. 2).—The spiderling as the little spider after the first moult may be called, has its limbs all free. Though it can now move, it does not make free use of its limbs but remains more or less quiet in the silky tangle of the cocoon. It is quite a plumpy individual of a yellowish colour. It has no particular similarity to the ants, the cephalothorax not possessing the characteristic constrictions. In this stage if the cocoon is opened the spiderlings shun the light and show great anxiety to crawl into the depths of woolly mass of the nest; otherwise they remain quiet but for certain slow movements of the legs which take place every now and then. It is more or less translucent, pigments being absent; and in many respects the creature is incomplete. The spinnerets, the jaws and the sense organs are not fully developed and the individual does not feed. Till it leaves the cocoon, the young spider is dependent on the yolk retained within its body.

In two days' time the hinder portion of the abdomen becomes dark blue with certain whitish transverse bands caused by rows of white hairs. The ocular region is now distinct and the eyes are marked by dark pigmentation. The arrangement of the eyes, however, is quite different from that seen in the adult or even in the next stage. The spinnerets too are completed and produce silk but in very small quantities. The little spiders are not very active but when disturbed they crawl about and the little silk thread which hardens slowly may be noted attached to the spinnerets.

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The Second Moult (Figs. 5 & 6.)—In about a week's time the yellow spiderlings moult. They have now become distinctly elongated and are clearly ant-like. All the yolk in the abdomen has been used up and it is now thin and elongated. The eyes are all developed. The young spiders remain for a considerable period within the cocoon. However, if the cocoon is disturbed or opened they rush out and move about in a very active manner. *It is in this stage that they finally emerge from the cocoon.* They are ant-like in form and movements. Like the adults these lift up their first pair of legs and wave them continuously as they move about.

The body is dark coloured with a deeper colouration for the cephalic part and for the hinder half of the abdomen. The young spider at this stage possesses a very striking similarity to the small dark brown ants so common here (*Prenolepis*) and also, to a less extent, to the small black ants (*Dolichoderinae*). It is interesting to note that these spiders, in this stage, are often seen in the company of these ants or in proximity to their nests. Whether they deliberately choose such localities is more than one can ascertain; for, quite often, they have been encountered in other situations as well, not particularly close to any dark ant colony.

What really happens seems to be this. In this stage the young spiders leave the cocoon often waiting for suitable fine weather. They emerge and swarm up the twigs in a most busy manner. They do not wait to reach the topmost twigs but immediately spin forth silk threads, which the first gust of wind catches, and they are carried away to diverse places. It is quite likely that many of these individuals are thus brought to places near which there are nests or colonies of the dark brown or black ants. Some of course would be carried to localities away from these ants, but this is less likely, since most trees on which they would land, would have some type or other of these little ants on them. Be this as it may, it is clear that this similarity to these well-known types of ants must be of high protective value to the spiders and quite naturally this would be more efficient in the proximity of their models than away from them.

From this stage the development of the young spiders is not quite uniform. Some individuals moult rapidly, and go through their life history in a shorter time than others. It has been found that males generally get through their life cycle much more rapidly than females. Another interesting feature noted after this stage is that the shades of colour of the spiders vary to a certain extent.

The Third Moult.—The next moult takes place after an interval of time—varying from nine days to a month. To a certain extent, this *variability* seems to depend upon the food supply. The spiders are now large and the colour of most of them turns a shade lighter. As a rule, they are neither too big nor too light coloured to lose their similarity to the small brown ants. Some however retain the dark colouration of the previous stage, while others become quite reddish yellow, the hinder half of the abdomen alone retaining the dark colour. These latter manifest a very real

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resemblance to the small stinging ants, the *Solenopsis* so common here.

The Fourth Moult.—The next moult also takes place after varying intervals in different specimens. The shortest period observed was 16 days. At this moult, there is a definite tendency for the spiders to assume a lighter colour. Most of them are yellowish brown and when they move about with the front legs stretched forth and waving, they resemble the *Plagiolepis* ants to a remarkable extent. I have taken specimens of this spider at this stage from plants on which a number of these ants were busy; but quite often these young spiders have been found in other situations as well.

The size and colouration of the spiders at this stage might also entitle them to be regarded as mimics of the minor workers of the Red ant *Oecophylla;* but it is decidedly from the next stage onwards that they put on the most striking similarity to this ant. However, near a stream of Red Ants in which the minor workers are mingled with the major workers, the spiders at this stage may quite easily pass for one of these minor workers. In this connection it is worth while noting that the *Oecophylla* ants are graded into major and minor workers which enable the later immature stages and the smaller individuals of the adults themselves—for the adult spiders are known to vary considerably regarding their size—to have suitable models.

The Fifth Moult.—The earliest interval after which the next moult takes place is two weeks. After this moult, the spiders are in the penultimate stage and have almost attained the adult size and are perfect mimics of the *Oecophylla.*

The Sixth Moult.—These in another three weeks, at the earliest, undergo the final moult. In this adult stage the sexes differ in appearance from each other—the male being larger and easily distinguishable from the female by the possession of a pair of horizontally extended chelicerae in front.

Such is the interesting life-history of this spider. It is clear from the above that the young ones are not left unprotected but that they too share in the advantages of mimicry. But if they are mimics, what are their suitable models? The *Oecophylla* which is mimicked by the adult, it is true, lays eggs but the tiny creatures that come out of them are not in the least ant-like, and when at last they put on their final garb they are too big for the spiderlings to serve as models. The young spider cannot mimic the mature Red ant—the model of the adult, however, by a slightly altered colouration it becomes a perfect mimic of some other species of ant that is more or less approximate to it in size. Thus the young *M. platalcoides*, which just escape from the cocoon, are so like the small brown ants that they may easily be mistaken for them while in their proximity. I have many times come across these spiders on plants infested by the brown ants and I hold that distinction between the spider and the ant under these conditions is not quite easy. Later on they mimic other types of ants and show corresponding modifications in general appearance and colouration.

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This is a unique life-history. The spider is not only an ant-mimic in its adult stage but the privileges of ant-mimicry seem to be extended throughout its life-history. A few instances comparable to a certain extent with this life-history have been described by certain observers. In 1908, Vosseler gave an account of the African Tettigoniid, *Eurycorypha* which begins life as an ant-mimic but becomes leaf-like in the final stage. It is interesting to note that the ant-like larva of *Eurycorypha* has long been described under a different generic name *Myrmecophana* and thus supposed to be quite a different animal.

In the *Transactions of the Entomological Society* for 1922, Mr. Uvarov gives an account of *Leptoderes ornatipennis*—a leaf-like long-horned grasshopper from Java—which first mimics a *Collyris*, one of the tiger beetles, and later the *Tricondyla*, another genus of tiger beetles and in the final stage resembles a leaf. Another transformation beginning in an ant-like larva and ending in a leaf-like adult has been described in the life-history of an Indian grasshopper *Isopsera pedunculata* by Major Hingston in the *Journal of the Bombay Natural History Society*, vol. xxxiii, No. 3, p. 497. I have observed a similar life-history in the case of a common mantis and a bug from South India an account of which will be given elsewhere.

Such cases, where one insect mimics in different stages of its post-embryonic development certain other insects such as different ants or tiger beetles and finally assumes the shape and colouration of a leaf, have been termed '*Transformational Deceptive Resemblance*'. The life-history of *M. plataleoides* given above, however, differs from these instances in that it resorts to only one type of protective resemblance in its life-history namely mimicry, while these examples show mimicry at the earlier stages which later on passes into protective colouration. In the life-history of *M. plataleoides* full advantage seems to have been taken of the fact that the general plan of structure of the ants is so uniform. An alteration of colour corresponding to a difference in size makes the spider in its successive post-embryonic stages a successful mimic of different types of ants.

Since all through the different stages of this spider, it manifests the phenomenon of mimicry and since during these successive stages by certain slight alterations in appearance and colouration it mimics different kinds of ants, it is suggested that this restricted type of 'Transformational Deceptive Resemblance' may be called 'Transformational Mimicry'.

Explanation of the Text-figures.

Fig. 1.—The young spider just escaped from the egg membrane.
Fig. 2.—The spiderling immediately after the first moult.
Fig. 3.—The spiderling—later stage—as seen from the side.
Fig. 4.—The spiderling—later stage—as seen from above.
Fig. 5.—The young spider after the second moult as seen from above. In this stage it escapes from the cocoon and has become ant-like.
Fig. 6.—The young spider after the second moult, as seen from the side.
Fig. 7.—The young spider after the third moult.
Fig. 8.—A. Front portion of the adult male.
B. Front portion of the adult female.

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ON THE TYPE LOCALITY AND SYNONYMY OF *EOGLAUCOMYS FIMBRIATUS* AND ITS LOCAL RACES.

BY

J. L. Chaworth-Musters.

[From the Department of Zoology, British Museum (Nat. Hist.).]

The type of *Sciuropterus fimbriatus* Gray (B.M. No. 37.6.10.55) is labelled as coming from 'India' and no more definite locality is given either on the label, or in Gray's original description of the species. This specimen was obtained by the Museum by purchase on the sale of the collection of Col. Cobbe on his death in 1836. Through the courtesy of the India Office I have been able to consult the record of service of Col. Cobbe in order to discover if at any time he was stationed anywhere within the area of distribution of this species. The result was negative. All the places mentioned in this record were in Central India or Bengal and it is probable that he received his specimen from friends stationed in the Hills and the most likely place from which he would have obtained it is Simla. I have compared the type with a series of specimens from Simla and they are, allowing for fading, identical. Therefore the typical locality for *Eoglaucomys fimbriatus* Gray, should be regarded as Simla until more definite evidence is forthcoming.

Examination of the large series of this species in the British Museum shows that it can be divided into two races; the eastern typical race, and a larger, lighter western race to which the name *baberi* Blyth is assignable.

The genus *Eoglaucomys* therefore contains one species divided into two races. They are:—

Eoglaucomys fimbriatus fimbriatus (Gray).

1837. Sciuropterus fimbriatus Gray, Mag. Nat. Hist., new series, vol. i, p. 584.

Type locality. Simla.

Eoglaucomys fimbriatus baberi (Blyth).

1847. Sciuropterus barberi Blyth, Journ., Asiat. Soc., Bengal, vol. xvi, p. 866.

Type locality. Mt. District Nijrow, Kohistan.

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A NOTE ON *SCIUROPTERUS GORKHALI* LINDSAY WITH REMARKS ON *PETAURISTA CANICEPS* AND ITS ALLIES.

BY

J. L. Chaworth-Musters.

[From the Department of Zoology, British Museum (Nat. Hist.).]

Helen Lindsay (*Journal, Bombay Natural History Society*, vol. xxxiii, No. 3, p. 565, 1929) described under the name of *Sciuropterus gorkhali* a species of flying squirrel from Nepal. In undertaking a revision of the Palaearctic *Pteromyidae* I had occasion to study the specimens upon which Mrs. Lindsay's species were based and after careful comparison, I have come to the conclusion that it cannot possibly be separated from *Petaurista caniceps* (Gray). Mrs. Lindsay was apparently led astray in her conclusions by two misunderstandings. In her paper she states that the two figures portraying *Sciuropterus senex* in Hodgson's 'Drawings of Mammalia' represent animals of different sizes. Reference to Hodgson's figures show that the two plates are drawn to different scales and the slight difference in colour may be easily accounted for by seasonal or individual variation or by the fact that the plates were drawn at different times and perhaps by different artists. Both plates portray a large Flying Squirrel with a grey head and we must believe that Hodgson realised that they portrayed the same animal when he labelled them with the same name. The skins which Mrs. Lindsay was studying were considerably shrunken owing to the fact that they had not been stuffed out with any material. On the other hand the skins of *Petaurista caniceps* and the type-specimens of *Sciuropterus senex* in the British Museum collection have no measurements taken in the flesh and may, as is often the case in old specimens be considerably over-stuffed. This has made comparison in regard to size extremely difficult, but measurements of the hindfoot and ear in the dry skin show that there is little difference between the species. I have carefully examined the skulls of *Sciuropterus gorkhali* and except for their slightly smaller size, as shown in Mrs. Lindsay's table of measurements, I can find no constant character by which they may be distinguished from the skulls of *Petaurista caniceps*.

Owing to this slight difference in size and its brighter colour *Sciuropterus gorkhali* must however be considered as a valid subspecies of *Petaurista caniceps*.

In regard to the systematic position of *Sciuropterus senex* the type-specimen B.M. No. 45.1.8. 242 is identical with specimens of *Petaurista caniceps* from Sikkim and it must be regarded as a synonym of that species.

From a careful examination of the material in the British Museum it is obvious that *Petaurista xanthotis* and *clarkei* must

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be considered as geographical races of *Petaurista caniceps*, and it is probable that this species through forms such as *Petaurista melanopterus*, *filchnerinae* and *watasei*, from Northern China and Manchuria, may connect up with *Petaurista leucogenys* of Japan and Korea. The material in the British Museum from Northern China is at present far too scanty to form a basis upon which to give a definite opinion as to whether all these forms should be considered races of one species *Petaurista leucogenys*.

The synonymy and races of *Petaurista caniceps* are:—

Petaurista caniceps caniceps (Gray).

1842. Sciuropterus caniceps Gray, Ann. Mag. Nat. Hist. Ser. 1, vol. x, p. 262.

1844. (Sciuropterus) senex Hodgson, Journ. Asiat. Soc., Bengal, vol. xiii, p. 68.

Type-locality. Darjeeling.

Petaurista caniceps gorkhali (Lindsay).

1929. Sciuropterus gorkhali Lindsay, Journal, Bomb. Nat. Hist. Soc., vol. xxxiii, p. 565.

Type-locality. Gorkha, Nepal, 12,000 ft.

Petaurista caniceps xanthotis (Milne Edwards).

1872. P[teromys] xanthotis Milne Edwards, Rech. Mamm., p. 301.

Type-locality. Moupin, Szechwan, Western China. (Thomas).

Petaurista caniceps clarkei, Thomas.

1922. Petaurista clarkei Thomas, Ann. Mag. Nat. Hist. Ser. 9, vol. x, p. 396.

Type-locality. Mekong Valley at 28° North, Western China, 9,000-10,000 ft.

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A NOTE ON THE BIRDS OF GHAZIPUR.

BY

REV. F. S. BRIGGS.

The town of Ghazipur lies in the Eastern part of the United Provinces, on the north bank of the Ganges. The Civil District of the same name also, lies, for the most part, on the north bank of the river, but one part of it, the Tehsil of Zamania, is on the south bank. Most of the District is under cultivation. In the immediate neighbourhood of Ghazipur itself there are large plantations of Guava, Mango, and Custard-apple. In parts there are wide stretches of *Usar* (barren ground), and there are occasional small patches of *Dak* jungle. The area liable to annual flooding, known locally as the *Diara* is of interest, as several species of birds are commoner there than anywhere else, and, in some cases, only occur there.

The climate is more like that of Bihar than of the greater part of the United Provinces, being very humid. The rainfall is not very heavy, being only about forty-five inches annually. But the fact that when the more western districts of the province are subject to the hot, dry west wind, or 'loo', Ghazipur generally has a damp east wind tends to increase the humidity of the atmosphere.

In the following notes subspecific identifications are only given where there can be no room for doubt. Unfortunately very few specimens were collected, hence the number of subspecific identifications is small.

For the sake of completeness I have added notes on species which have been observed in the Benares and Azamgarh Districts but not in the Ghazipur District. It seems probable that they also occur in the latter district. Such species, with the notes on them, have been enclosed in square brackets.

Corvus macrorhynchos Wagl. The Jungle Crow.

Numerous everywhere. The species breeds as freely in the station itself as in the surrounding country. Out of the breeding season Jungle Crows appear to gather nightly from a very wide area to some point so far undiscovered north-west of Ghazipur. Eggs are laid at varying times from the beginning of March to the end of April.

Corvus splendens splendens (Vieillot). The Indian House Crow.

Most of the remarks on the last species apply also to this one. They appear to roost in the same place as the last, as both Jungle and House Crows frequently fly north together at sunset. Eggs are laid in June, and the nests are more carefully concealed than those of the last species.

Dendrocitta rufa (Latham.) The Indian Tree-Pie.

A common pest. The number of eggs of small birds, particularly of Red-vented Bulbuls, destroyed by the Tree-Pie must be immense. This bird appears to breed in March, April, and possibly May, but is an adept at concealing its nest.

Sitta castanea (Lesson). The Chestnut-bellied Nuthatch.

Numerous wherever there are trees, but particularly in gardens. They occasionally catch small moths on the wing after the fashion of a Flycatcher. Judging from the time young birds begin to appear eggs are laid early in March.

Turdoides somervillei (Sykes). The Jungle Babbler.

Quite the commonest bird about Ghazipur. In the station every garden seems to have its flock. They are less common in the country. On October 16, 1930 a pair were seen feeding two young Pied Crested Cuckoos in trees opposite the compound of my bungalow. They appear to breed all the year round, but more commonly between March and August than at other times. There are no grounds for believing that they are anything but single-brooded.

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Argya caudata (Dumont). The Common Babbler.
One seen in a Jasmine field on the outskirts of Ghazipur, 20-1-20. No other record.

Argya malcomi (Sykes). The Large Grey Babbler.
Extraordinarily local. A flock is always to be seen in some acacias at the south-west corner of the golf-links, except during the rains, when they seem to disappear. Apart from this flock I have only once seen the species, at the western corner of the District.

Aegithinia tiphia Linnaeus. The Common Iora.
Not seen during the cold weather. It was fairly numerous during the hot weather and rains of 1930, but was only seen about three times during the hot weather of 1931.

Molpastes cafer saturatus Whistler. The Red-vented Bulbul. ♂ 30-6-30, ♂ 19-7-30.
This species is less common about Ghazipur than in most parts of the Indian plains. The average height of their nests above the ground is greater than in other places. One nest I found was forty feet up a mango, and I have found none in this district below twelve feet. Eggs are laid from the middle of April till July, and possibly later.

[**Elathea jocosa** (Linnaeus). The Red-whiskered Bulbul.
This species was not observed in the Ghazipur District, although it is not uncommon at Benares, forty-five miles west, and is common at Azamgarh, about the same distance north.]

Saxicola torquata (Linnaeus). The Stonechat.
One seen at Mohammadabad, 6-11-29, and one or two near the northern boundary of the district the following autumn. Presumably all were on passage. It is surprising that this species is not commoner; and still more surprising that *Saxicola caprata* was not recorded at all.

Oenanthe deserti Temminck & Laug. The Desert Wheatear.
One seen perched on a mohwa tree, 24-1-30. No other record.

[**Cercomela fusca** (Blyth). The Brown Rock-Chat.
Not recorded in the Ghazipur District, but occurs at Azamgarh.]

Phoenicurus ochrurus (Gmelin). The Black Redstart.
A common winter visitor. The males appear to outnumber the females slightly. Earliest date seen September 11. Latest date not recorded.

Cyanosylvia suecica (Linnaeus). The Bluethroat.
Occurs in the cold weather, but not in great numbers. It is more often seen on the *Diara* than elsewhere, and is numerous there in tamerisk scrub in the spring. Latest date seen April 2. One white-spotted individual only was seen, 30-1-30.

Calliope calliope. (Pallas). The Rubythroat.
Two or three seen feeding in long grass and jasmine plantation on the outskirts of Ghazipur, 3-12-29.

Saxicoloides fulicata cambaiensis (Latham). The Brown-backed Indian Robin.
Resident in considerable numbers. Eggs are laid at least from the end of March to the beginning of July, and perhaps earlier and later than these dates.

Copsychus saularis (Linnaeus). The Magpie Robin.
Resident in smaller numbers than the last species. Breeds in the rains.

Turdus atrogularis Temminck. The Black-throated Thrush.
One seen 20-11-31. No other record.

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[**Monticola solitaria** (Linnaeus). The Blue Rock-Thrush.

Not seen in the Ghazipur District, but one seen at Sarnath, Benares District, 25-2-30.]

Siphia parva (Bechstein). The Red-breasted Flycatcher.

Fairly numerous throughout the cold weather, and very much more so on migration, particularly in the autumn. Females (or juveniles) appear to arrive first. These were numerous at the end of October and throughout November and December in 1929, but no red-breasted males were seen till December 21. The same phenomenon was noted in the two succeeding years, but dates were not recorded.

[**Stoparola melanops** (Vigors). The Verditer Flycatcher.

Not recorded in the Ghazipur District, but one seen at Azamgarh, 4-12-31.]

Tchitrea paradisi (Linnaeus). The Paradise Flycatcher.

In the Ghazipur District this species appears to occur both as a passage migrant in the spring and autumn, and as a rains visitor. As passage migrants they pass through in April and May, and again in October. The breeding birds appear to be established about the middle of June, and to leave in September, immediately after breeding. Eggs are laid in the earlier part of July, mangoes and guavas being the trees most usually chosen for the nest.

Leucocerca aureola Lesson. The White-browed Fantail Flycatcher.

A resident in considerable numbers.

Lanius excubitor Linnaeus. The Grey Shrike.

This is the commonest of the four *Lanii* met with at Ghazipur, but is by no means common. The few that occur appear to be resident, and to keep closely to their breeding locality. They seem to occur only on *usar* and the *Diara*. They breed in March, and probably also in the rains.

Lanius vittatus Valenciennes. The Bay-backed Shrike.

One in immature plumage seen on the outskirts of Ghazipur 27-1-30, and one in adult plumage near the same spot 28-3-30. No other record.

Lanius schach Linnaeus. The Rufous-backed Shrike.

Occasionally seen at all seasons.

Lanius cristatus Linnaeus. The Brown Shrike.

One seen south of the Ganges 21-12-30. For two or three days in early December, 1931, they were very numerous on the Ghazipur golf-links. No other records.

Tephrodornis pondiceriana (Gmelin). The Wood-Shrike.

Fairly common wherever there is cover, particularly amongst the fruit-gardens round Ghazipur. Appears to be resident.

Pericrocotus brevirostris (Vigors). The Short-billed Minivet.

A winter visitor in small numbers.

Pericrocotus peregrinus (Linnaeus). The Small Minivet.

Numerous, but erratic in its occurrence. Its appearances and disappearances do not seem to be connected with the season. A flock which contained some young birds which could not, from their appearance, long have left the nest, was seen near the church at Ghazipur on 2-11-31.

Graucalus macei Lesson. The Large Grey Cuckoo-Shrike.

Fairly common, and appears to be resident.

Lalage sykesii Strickland. The Black-headed Cuckoo-Shrike.

Occasionally seen, never in the cold weather. One was seen building a nest in a mango on the outskirts of Ghazipur 16-7-31. The branch on which the nest was placed was blown down in a storm before it was laid in.

Campophaga melanschista Hodgson. The Dark Grey Cuckoo-Shrike.

Occasionally seen.

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Dicrurus macrocercus (Vieillot). The Black Drongo or King Crow. ♂ 23-6-30, ♂ 10-7-30.

Numerous at all seasons. The majority of eggs are laid about the end of June and the beginning of July, but some are laid a good deal later, and possibly some earlier.

Dicrurus longicaudatus Jerdon. The Ashy Drongo.

Occasionally seen, most frequently in March, when the species sings. The song varies considerably in individual birds; but the best songsters amongst them are quite equal to the best performers among Indian birds.

Dicrurus coerulescens (Linn.). The White-bellied Drongo.

One seen on the outskirts of Ghazipur 5-11-29. One was seen, probably the same individual, in the same place for several days after this. No other record.

Orthotomus sutorius (Pennant). The Tailor-Bird.

Surprisingly scarce. One came into my bungalow to hunt for insects on several occasions, and a pair haunted the garden most of the two and a half years I was there, but elsewhere I very rarely met with the species.

Cisticola juncidis (Rafinesque). The Fantail Warbler.

Fairly numerous, particularly in fields of Jasmine. This species occasionally seems to disappear entirely without any visible reason.

Phylloscopus inornatus Blyth. The Yellow-browed Warbler.

One seen near Mahommedabad, 6-11-29. This was the only *Phylloscopus* (except *collybitus*) identified. On the whole *Phylloscopi* seem to be less numerous winter visitors in the Ghazipur District than in most parts of Northern India.

Phylloscopus collybitus (Vieillot). The Chiff-chaff.

Two seen 18-12-31, one of them singing rather half-heartedly.

Prinia socialis Sykes. The Ashy Wren-Warbler.

Fairly common, especially in sarpat and on the *diara*.

Prinia inornata Sykes. The Indian Wren-Warbler.

One of the commonest birds in the District. It appears in this District to build exclusively in sarpat, where the nest is not even very carefully concealed. Eggs are mostly laid in the last week of July and the first week of August.

Oriolus oriolus (Linnaeus). The Golden Oriole.

A summer visitor, and probably also a passage migrant. It appears at the beginning of April, but its numbers appear to decrease somewhat before the end of the month. Eggs are laid in June. It leaves early in October.

Oriolus xanthornus (Linnaeus). The Black-headed Oriole.

Occurs at all seasons, but in greater numbers in winter than in summer. The decrease in the number of Black-headed Orioles in the spring seems to coincide with the arrival of the Golden Oriole, and their autumn increase with the departure of the Golden Oriole.

Pastor roseus (Linnaeus). The Rosy Starling.

Occasionally seen, never in large numbers, between November and March.

Sturnia malabarica (Gmelin). The Grey-headed Myna.

Appears to be resident in small numbers. In February and March there seem to be more of these birds about, and they congregate at that season in great numbers round the blossoms of the Silk Cotton Tree. This increase may, however, be only apparent, as they are a good deal shyer and more difficult to observe than most members of their family.

Temenuchus pagodarum (Gmelin). The Brahminy Myna.

Resident in considerable numbers. Eggs laid in June; possibly also in May.

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Acridotheres tristis (Linnaeus). The Common Mynah.

Very numerous. Out of the breeding season these birds appear to roost in the same neighbourhood as the Jungle and House Crows. The breeding season appears to extend from March to September, but the majority of eggs seem to be laid in July. In two successive years a pair of them built in a hole in the wall of my office after it had been vacated by a pair of Indian Spotted Owlets.

Acridotheres ginginianus (Latham). The Bank Mynah.

Fairly numerous. During the late summer and the cold weather they frequently feed in mixed flocks with other members of the same family. In April a large number of them disappear from their usual haunts, possibly to breed in some of the sand cliffs of the River Ganges. No large colonies of breeding birds observed, but two or three pairs may often be found breeding in a well. Eggs laid early in May.

Sturnopastor contra (Linnaeus). The Pied-Mynah.

Numerous and resident. In the autumn these birds come into the station, often feeding in mixed flocks with Common, Bank, and Brahminy Mynas. In the spring they leave the station for the surrounding country. Nests are built in Acacias, eggs being laid in July and August.

Ploceus philippinus (Linnaeus). The Baya or Weaver-Bird.

Resident, but not very numerous.

Uroloncha malabarica (Linnaeus). The White-throated Munia.

Resident and numerous. Most eggs are laid from January to March.

Uroloncha punctulata (Linnaeus). The Spotted Munia.

Occasionally seen, generally in small flocks in Jasmine gardens and Sarpat.

Amandava amandava (Linnaeus). The Red Munia or Amadavat.

Occasionally seen, sometimes in pairs, more often in flocks, either homogeneous or mixed with the last species.

Carpodacus erythrinus (Pallas). The Common Rosefinch.

A flock in which some of the males were beginning to assume breeding-plumage was seen 25-1-30. They occur from about that date till the latter half of February in varying numbers, giving the impression that they are passing through. None noted on the autumn passage.

Gymnorhis xanthocollis (Burton). The Yellow-throated Sparrow.

Appears to be resident in small numbers. Numbers increase in the spring.

Passer domesticus (Linnaeus). The House Sparrow.

Fairly numerous. Breeds irregularly, but chiefly in March and April. To overcome the nuisance of having these birds building inside their bungalows some of the European inhabitants put up nest-boxes in their verandahs. This measure seems quite successful, the Sparrows accepting the nest-boxes provided in preference to the inside of bungalows.

Riparia paludicola (?) (Vieillot). The Indian Sand-Martin.

Fairly numerous. Breeds in November. As no specimens were obtained it must remain doubtful whether the species is *paludicola* or *riparia*.

Hirundo rustica Linnaeus. The Common Swallow.

Occasionally seen in small numbers in October and November. Not recorded in any other months.

Hirundo smithii Leach. The Wire-tailed Swallow.

Occurs in small numbers in the hot weather and rains. Not noted in the cold weather.

Hirundo daurica Linnaeus. The Red-rumped Swallow.

Resident, breeding as soon as the rains break. In addition to the resident birds great numbers occur at intervals in the months of November, January, February, and March. When these large flocks appear they always seem to be entirely composed of very tired birds, which swarm on certain trees,

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especially mangoes and high bamboos. They rarely stay more than one day. Probably they belong to a different race from the resident birds, but unfortunately no specimens were secured.

Motacilla alba Linnaeus. The White Wagtail.

Exceedingly numerous from October to March. Earliest date seen October 5. Latest date not noted.

Motacilla cinerea Tunstall. The Grey Wagtail.

Fairly numerous, but never in flocks, throughout the cold weather.

Motacilla flava Linnaeus. The Grey-headed Wagtail.

Occurs throughout the cold weather, but in greater numbers in spring and autumn than in the winter months. Both on migration and when established in winter quarters mixed flocks of this species and *M. alba* are by no means uncommon.

Anthus trivialis (Linnaeus). The Tree-Pipit.

A winter visitor in large numbers (October to March).

Anthus richardi rufulus (Vieillot). The Indian Pipit.

Occasionally seen, chiefly on '*usar*', at all seasons.

Calandrella acutirostris Hume. The Short-toed Lark. ♂ 7-4-30.

The above specimen was shot from a large flock on the '*diara*'. They occur in autumn and spring, but I have not noted them in the winter.

Mirafra erythroptera Blyth. The Red-winged Bush-Lark.

Occasionally seen, almost invariably on '*usar*', at all seasons.

Galerida cristata chendoola Franklin. The Indian Crested Lark. ♂ December 30.

Not uncommon on the '*diara*' and on '*usar*'; rarely seen elsewhere. Resident.

Ammomanes phoenicura (Franklin). The Rufous-tailed Finch-Lark.

Appears to be resident in small numbers.

Erenopterix grisea grisea Scopoli. The Ashy-crowned Finch-Lark. ♂♂♀ 2-10-30.

In the cold weather this bird occurs in large flocks on the '*diara*' and '*usar*'. In summer it occurs sparingly in pairs everywhere. The flocks appear to break up about the end of February.

Zosterops palebrosa (Temminck). The White-eye.

Fairly numerous, and appears to be resident. As in other places this species seems to appear at once in great numbers immediately after the fall of unseasonable rain. Eggs are laid in June and July.

Cinnyris asiatica (Latham). The Purple Sunbird.

Common at all seasons. The earliest date at which a male was seen in breeding plumage was November 17th, south of the Ganges. Nests containing eggs or young were found from February 21 to May 5. In this district the species seems to have a strong preference for prickly pears as a site for a nest. Every nest found, with two exceptions, were suspended from the thorns of prickly pear bushes. Of the two exceptions, one was suspended from a bush growing five feet below the surface of the ground in a disused well, and the other on a young neem inside a brick protector-wall.

Piprosoma agile (Tickell). The Thick-billed Flower-pecker.

Fairly common, and apparently resident. It is usually to be seen in mango groves.

Liopicus mahrattensis (Latham). The Mahratta Woodpecker.

Fairly numerous and resident.

Yungipicus nanus (Vigors). The Pigmy Woodpecker. ♂ 11-12-29.

This one specimen was obtained from a grove of mangoes on the south side of the Ganges. No other record.

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Brachypternus benghalensis (Linnaeus). The Golden-backed Woodpecker.

Resident in considerable numbers, particularly in the station itself and the fruit plantations surrounding it.

Iynx torquilla. Linnaeus. The Wryneck.

One seen 20-2-31. No other record.

Thereiceryx zeylanicus (Gmelin). The Green Barbet.

Very numerous wherever there are trees. At no season is this bird completely silent. Any sudden noise at night wakes them up and sets them calling.

Xantholema haemacephala (P. L. S. Müller). The Coppersmith.

Numerous and resident. Most eggs are laid in April. From an excavation begun on the seventeenth of March two eggs were taken on the seventeenth of April.

Hierococcyx varius (Vahl). The Common Hawk-Cuckoo, or Brainfever Bird.

Appears to be a summer visitor only, though the fact that even when calling this bird is more often heard than seen makes one wary of stating that none remain for the winter. During the hot weather and the rains the Brainfever Bird occurs in large numbers. The earliest date at which it was heard calling was February 13th. From that time till the end of September or beginning of October there are few days on which it may not be heard. Its vocal activity is greatly increased immediately on the breaking of the rains.

Clamator jacobinus (Boddaert). The Pied Crested Cuckoo.

Occurs in large numbers as a rains visitor. In 1930 it was first recorded on June 17th, and in 1931 on June 15th. It grows noticeably scarcer in September, and the last appears to have left by the end of October. On 16-10-30 two juveniles were seen being fed by one pair of Babblers in trees opposite my bungalow. The species is not particularly shy. On one occasion one was seen feeding on the ground only twenty yards to the right front of the firing point of the rifle range during rifle practice.

Eudynamis scolopaceus (Linnaeus). The Koel.

A numerous summer visitor. Earliest date seen and heard February 21.

Taccocua leschenaulti Lesson. The Sirkeer Cuckoo.

Fairly numerous and resident. Chiefly seen on *usar* and open arable land.

Centropus sinensis (Stephen). The Coucal or Crow-Pheasant.

Common and resident. Eggs laid in July.

Psittacula krameri (Scopoli). The Green Parrakeet.

Common at all seasons wherever there are trees. Eggs laid in the earlier part of April.

Psittacula cyanocephala (Linnaeus). The Blossom-headed Parrakeet.

Seen at all seasons on the northern borders of the District, but not elsewhere. This species is kept as commonly in cages locally as the last.

Coracias benghalensis Linnaeus. The Blue Jay or Indian Roller.

Common and resident. The mating-flight is commenced as early as the third week in February.

Merops orientalis Latham. The Green Bee-eater.

Common at all seasons.

Merops superciliosus Linnaeus. The Blue-tailed Bee-eater.

This bird is numerous, especially over tanks, in July, and is occasionlly seen in the following two months. I have no record of it at any other season.

Ceryle rudis Linnaeus. The Pied Kingfisher.

Occurs wherever there is suitable water.

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Alcedo atthis (Linnaeus). The Common Kingfisher.

Appears to be resident on those village ponds which hold water all the year round. In the rains they spread to those ponds which only hold water for part of the year, staying there till they dry up in the late winter. Not noticed on the river or large tanks.

Halcyon smyrnensis (Linnaeus). The White-breasted Kingfisher.

Occasionally seen at all seasons. In the Ghazipur District this species is noticeably scarcer than in most parts of the plains of northern India.

Tockus birostris (Scopoli). The Grey Hornbill.

Occasionally seen, chiefly in spring.

Upupa epops Linnaeus. The Hoopoe.

Very numerous at all seasons. Eggs are laid from the latter part of February and throughout March.

Micropus affinis (Gray). Indian House-Swift.

Numerous and apparently resident.

Tachornis batassiensis (Gray). The Palm-Swift.

Resident in considerable numbers. They breed in November, and possibly again in the spring.

Caprimulgus macrourus Horsefield. The Long-tailed Nightjar.

One seen at Sayedpur, 5-8-30. No other record.

Caprimulgus monticolus Franklin. Franklin's Nightjar.

Not uncommon in the station itself in the summer months. Numerous in the grounds of Ghazipur Club in the latter half of October and the earlier half of November.

Caprimulgus asiaticus Latham. Indian Nightjar.

Fairly numerous, and appears to be resident.

Tyto alba (Scopoli). The Barn Owl.

One seen near the railway between Sayedpur and Ghazipur, 9-11-29. No other record.

Athene brama (Temminck). The Spotted Owlet.

Very numerous. At least two pairs bred in my compound each year, one in a hollow Mohwa tree, and the other in a hole in a verandah wall. Eggs are laid about the end of February and the beginning of March. Observation of the nest in my verandah showed that both sexes take a share in incubation. All day one of the Owlets, apparently the male, sat on one of the verandah pillars, his eyes fixed on the entrance to the nesting hole, till about 2-30 or 3 p.m. At that time the one that had been sitting used to join the one on the pillar, and, after exchanging a few caresses, the one on the pillar went onto the nest, while the one from the nest flew off to feed.

Glaucidium radiatum (Tickell). The Jungle Owlet.

Fairly numerous at the west end of Ghazipur, in the now almost abandoned Cantonment. Rarely seen or heard elsewhere.

Pandion haliaëtus (Linnaeus). The Osprey.

One seen near Mohammedabad, at the east end of the District, 6-11-29. No other record.

Sarcogyps calvus (Scopoli). The King Vulture.

Common and resident. Several pairs of this species may often be seen at the same carcass.

Gyps indicus (Scopoli). The Indian Long-billed Vulture.

Less numerous than the last species.

Pseudogyps benghalensis (Gmelin). The White-backed Vulture.

The commonest Vulture at Ghazipur.

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Neophron percnopterus (Linnaeus). The Neophron.
Not as numerous as in most parts of India.

Gypaëtus barbatus (Linnaeus). The Lammergayer.
One seen on the northern border of the district, 27-2-31. No other record.

Falco jugger A. E. Gray. The Lagar Falcon.
One seen near Mohammedabad, 6-11-29. Not identified with certainty on any other occasion.

Falco tinnunculus (Linnaeus). The Kestrel.
Occasionally seen in the cold weather. One seen near Shahabpur on 3-1-30 was an unusually brightly coloured bird for the Indian Plains.

Aquila rapax (Temminck). The Tawny Eagle.
Fairly common.

Butastur teesa (Franklin). The White-eyed Buzzard.
Resident in small numbers.

[Haliaëtus leucoryphus Pallas. Pallas's Fishing Eagle.
A pair seen on Ghosi Jhil (just over the border of the Azamgarh District) 27-12-30. One was attacking Coot, which huddled together on the water in flocks of from forty to sixty strong for protection. It caught one on the wing, but dropped it, apparently unhurt.]

Haliastur indus (Boddaert). The Brahminy Kite.
Common and resident. It is common over the river, but most frequently seen over village tanks.

Milvus migrans (Boddaert). The Common Pariah Kite.
Not as numerous as in many other parts of India. Eggs laid in January and February.

Circus macrourus (S. G. Gmelin). The Hen Harrier.
Occasionally seen, chiefly over *usar*, in the cold weather.

Circus cyaneus (Linnaeus). The Pallid Harrier.
As the last.

Circus aeruginosus (Linnaeus). The Marsh Harrier.
Commoner from September to April than either of the last two species. Seen on every kind of open country.

Buteo rufinus (Cretz). The Long-legged Buzzard.
One seen 25-11-30. No other record.

Crocopus phoenicopterus (Latham). The Common Green Pigeon.
Fairly numerous, and apparently resident, but moving about within the district in accordance with the food-supply. A pair shot on 3-1-30 each had their crops stuffed with peas, which disproves the commonly made assertion that the species *never* comes to the ground.

Columba livia Bonnaterre. The Blue Rock-Pigeon.
Resident, breeding irregularly throughout the year.

Streptopelia chinensis (Scopoli). The Spotted Dove.
Fairly numerous and resident.

Streptopelia senegalensis (Linnaeus). The Little Brown Dove.
As the last species.

Streptopelia decaocto (Frivaszky). The Indian Turtle-Dove.
The commonest of the Doves in this District.

Oenopopelia tranquebarica (Herman). The Red Turtle Dove.
Appears to be a hot weather visitor only in small numbers. Eggs laid in April.

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Pterocles exustus (Temminck). The Common Sandgrouse.

A flock of about a dozen was seen flying over Nagsar Railway Station, south of the Ganges, 18-3-30. No other record.

Coturnix coturnix (Linnaeus). The Common Quail.

A winter visitor in surprisingly small numbers. Occurs more commonly on the *Diara* than elsewhere.

Francolinus pondicerianus (Gmelin). The Grey Partridge.

Resident in small numbers.

Amaurornis phoenicura (Pennant). The White-breasted Waterhen.

Fairly common, chiefly on well-shaded village ponds. This bird is regarded as a delicacy by the Chamar caste.

Ammurornis akool (Sykes). The Brown Crake.

Occasionally seen south of the Ganges.

Gallinula chloropus (Linnaeus). The Waterhen.

A few seen on Ghosi Jhil 27-12-30. No record within the borders of the District.

Porphyrio poliocephalus (Latham). The Purple Coot.

One seen on the village tank at Barodi, near the northern border of the district, 2-1-30. No other record.

Fulica atra Linnaeus. The Common Coot.

Common on all tanks and jhils of any size. Also occurs on the Ganges. On 16-3-30. on the river a House Crow was seen attacking a Coot. The latter dived at each swoop of the Crow to avoid it.

Anthropoides virgo (Linnaeus). The Demoiselle Crane.

Occasionally seen in the cold weather.

Burhinus oedicnemus (Linnaeus). The Stone-Curlew.

Resident in considerable numbers. Eggs mostly laid in April, but possibly both earlier and later as well.

Glareola lactea Temminck. The Little Indian Pratincole.

Resident in large numbers on the Ganges. Eggs are laid in the earlier half of April. When the rains bring out the swarms of flying termites these birds may be seen catching them on the wing in large numbers at a considerable distance from the river.

Cursorius coromandelicus (Gmelin). The Indian Courser.

Fairly numerous, and appears to be resident. The flesh of these birds is by no means bad eating.

Metapodius indicus (Latham). The Bronze-winged Jacana.

Numerous on all large jhils. Breed in the latter part of the rains.

Hydrophasianus chirurgus (Scopoli). The Pheasant-tailed Jacana.

Even more numerous than the last species, breeding on small tanks as well as on the larger jhils. A pair watched courting on 11-8-30 flew higher and higher till they amost receded from sight.

Lobivanellus indicus (Boddaert). The Red-wattled Lapwing.

Common and resident. In April 30 a pair laid their eggs on the flat roof of the Ghazipur Church.

Hoplopterus duvaucelii (Lesson). The Spur-winged Plover.

Seen on several occasions on sandbanks on the Ganges, and probably breed there, but no eggs were found.

Squatarola squatarola (Linnaeus). The Grey Plover.

Several feeding on the sand by the Ganges 30-4-31. No other record.

Charadrius dubius Scopoli. The Little Ringed Plover.

Occurs in small numbers in the winter.

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Himantopus himantopus (Linnaeus). The Black-winged Stilt.
Occurs in small numbers in the cold weather.

Recurvirostris avocetta Linnaeus. The Avocet.
Pair seen over the Ganges 27-1-31. No other record.

Numenius arquatus (Linnaeus). The Curlew.
Occurs in small flocks on the banks of the Ganges in winter.

Tringa hypoleuca Linnaeus. The Common Sandpiper.
A winter visitor in small numbers. Rather more numerous as a passage migrant in the autumn. Earliest date recorded October 10.

Tringa ochropus Linnaeus. The Green Sandpiper.
One or two wherever there is water in the cold weather.

Tringa nebularia (Gunner). The Greenshank.
Occurs in small numbers in the cold weather.

Erolia minuta (Leisler). The Little Stint.
Fairly numerous, chiefly in pairs or small parties up to half a dozen, throughout the cold weather. More numerous as a passage migrant both in spring and autumn. Latest date recorded April 2.

Erolia temminckii (Leisler). Temminck's Stint.
Less numerous than the last species.

Capella gallinago (Linnaeus). The Fantail Snipe.
Occurs wherever the ground is suitable in the cold weather.

Capella stenura (Bonaparte). The Pintail Snipe.
A pair seen near the Indian Cemetery 19-2-30. No other record.

Larus ridibundus Linnaeus. The Black-headed Gull.
One seen over the Ganges opposite the steamer ghat 16-3-30. No other record.

Larus brunicephalus Jerdon. The Brown-headed Gull.
Not uncommon on the Ganges from October to April.

Chlidonias leucoparcia (Temminck). The Whiskered Tern.
Several seen over Birhanpura Tank, 15-9-30. They may well have bred there. No other record.

Sterna nilotica (Gmelin). The Gull-billed Tern.
One seen over the Ganges 28-1-31. No other record.

Sterna seena Sykes. The Common River Tern.
Very numerous at all seasons. They feed wherever there is water, but gather to sleep on two or three sandbanks opposite the old cantonment of Ghazipur. In the rains, when these banks are entirely submerged, they may still be seen towards dusk flying in the same direction. Eggs are mostly laid in the earlier half of April. They and *Rhyncops albicollis* frequently lay on the same sandbank, but I have found no other species breeding with these two.

Sterna melanogaster Temminck. The Black-bellied Tern.
Much less numerous than the last species. Appears to be resident, but no eggs taken. This species is rarely seen away from the river.

Sterna albifrons Vroeg. The Little Tern.
Fairly numerous on the river. Like the last species it does not often occur away from the river. Eggs are laid in the earlier half of April. It breeds in mixed colonies with the Pratincole.

Rhyncops albicollis Swainson. The Indian Skimmer.
Fairly numerous on the Ganges. Eggs are laid in the first half of April, and some before the end of March. It appears to breed either in homogeneous colonies or only mixed with Sterna seena.

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Anhinga melanogaster Pennant. The Indian Darter.
Occurs in small numbers. Resident.

Ciconia ciconia Linnaeus. The White Stork.
Pair seen near Sadat, 2-1-30. No other record.

Dissoura episcopa (Boddaert). The White-necked Stork.
Common, but very local in its distribution. Local name Jangil. Amongst the lower castes of Hindus its flesh is esteemed a delicacy.

Ibis leucocephalus (Pennant). The Painted Stork.
One seen in a tank near Jakhanian, 5-2-30. No other record.

[**Ardea purpurea** Linnaeus. The Purple Heron.
Several seen on Ghosi Jhil, 27-12-30. No other record.]

Ardea cinerea Linnaeus. The Common Heron.
Appears to be resident in small numbers.

Egretta alba (Linnaeus). The Large Egret.
Seen at Shahabpur, 13-1-30. No other record.

Bubulcus ibis (Linnaeus). The Cattle Egret.
Fairly numerous and resident.

Ardeola grayii (Sykes). The Pond Heron or Paddy Bird.
Common wherever there is water.

Nycticorax nycticorax (Linnaeus). The Night Heron.
For some weeks at the end of 1930 two or three roosted daily in tall *nim* trees in my compound. No other record.

Ixobrichus cinnamomeus (Gmelin). The Chestnut Bittern.
One seen on the banks of the Ganges in the evening, Sayedpur, 26-10-31.

Sarkidiornis melanotos (Pennant). The Nukta.
Resident in small numbers.

Nettopus coromandelicus Gmelin. The Cotton Teal.
Resident and fairly numerous.

Anser anser Linnaeus. The Grey Lag Goose.
A fairly numerous winter visitor, occurring both on the Ganges and on tanks.

Anser indicus Latham. The Bar-headed Goose.
Less numerous than the last species.

Dendrocygna javanica (Horsfield). The Whistling Teal.
Numerous and resident.

Casarca ferruginea (Pallas). The Ruddy Sheldrake or Brahminy Duck.
Common in winter on the banks of the Ganges, sometimes seen on its tributaries. In the neighbourhood of Ghazipur most Europeans seem to believe that this bird feeds on corpses, and therefore avoid eating it. So far I have met no Indians who believe this, and its flesh is eaten by several castes.

Anas platyrhyncha Linnaeus. The Mallard.
Occurs occasionally in the cold weather, never in great numbers. In some years none are shot.

Anas poecilorhyncha Forster. The Spotbill.
Several seen on Bishanpura Tank, 15-9-30. No other record.

Chaulelasmus streparus (Linnaeus). The Gadwall.
Occurs in comparatively small numbers in the winter.

Mareca penelope (Linnaeus). The Wigeon.
A regular, but not very numerous winter visitor.

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Nettion crecca (Linnaeus). The Common Teal.
Numerous throughout the cold weather and well into April.

Querquedula querquedula (Linnaeus). The Blue-winged or Garganey Teal.
By no means so numerous as the last species, but stays even later.

Dafila acuta (Linnaeus). The Pintail.
Occurs in the cold weather, but not in large numbers. It is more numerous as a passage migrant in the autumn than as a winter visitor.

Spatula clypeata (Linnaeus). The Shoveller.
Numerous throughout the cold weather.

Netta rufina (Pallas). The Red-crested Pochard.
A winter visitor in small numbers.

Nyroca nyroca Güldenstädt. The White-eye.
This appears to be the most numerous of the migratory Ducks in the District.

Nyroca ferina (Linnaeus). The Pochard.
Less numerous than the last species, but more so than *N. rufina*.

Nyroca fuligula (Linnaeus). The Tufted Duck.
A few appear to be shot every winter, but they are never very numerous.

[**Podiceps cristatus** (Linnaeus). The Great Crested Grebe.
Very numerous on Ghosi Jhil, 27-12-30. Not seen within the borders of the District.]

Podiceps ruficollis (Vroeg). The Little Grebe.
Very numerous wherever there is permanent water. Eggs appear mostly to be laid in August, but some must be laid later, as a family of very young chicks was seen on a tank near my bungalow on 31-11-31 and for several days afterwards.

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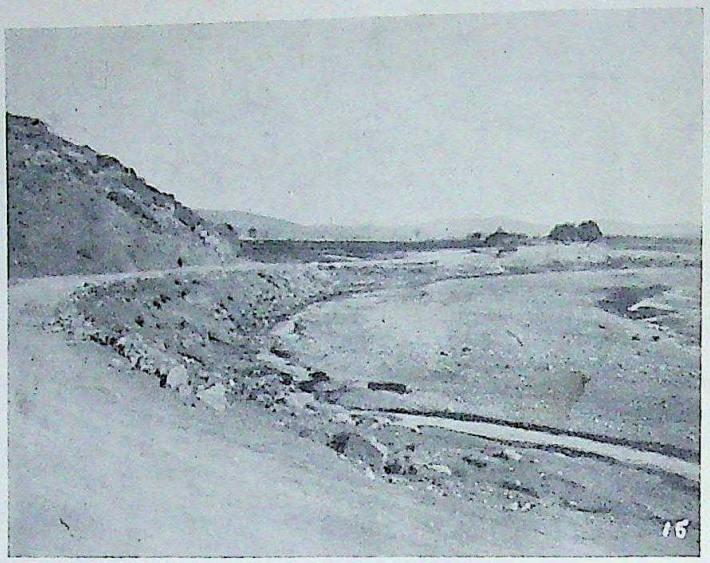
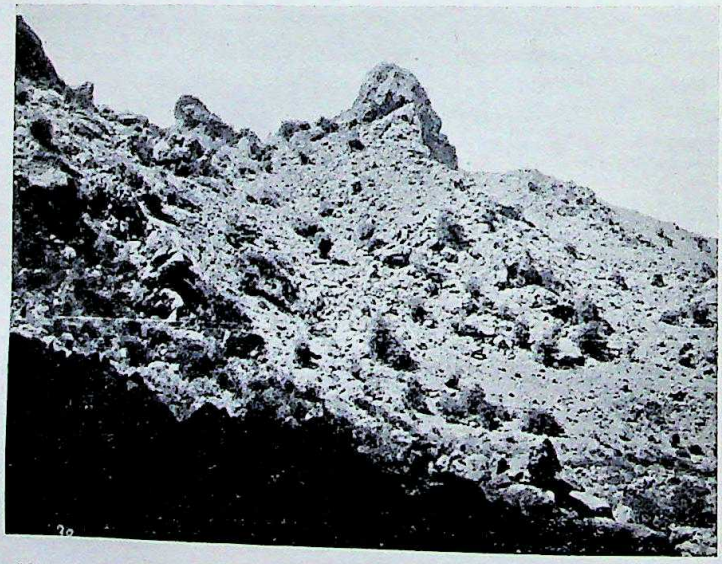


12. Right bank of Chasmai River near Miram Shah Fort.



13. A single peak of the hill-range E. of Miram Shah Fort. Plants *Monotheca buxifolia* Dcne., *Acacia modesta* Wall., *Nannorhops Ritchieana* H. Wendl., *Periploca aphylla* Decaisne. On the top *Periplora* and *Acacia modesta*.

Photos by J. Fernandez.

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THE FLORA OF WAZIRISTAN.

BY

THE LATE E. BLATTER, S.J., PH.D., F.L.S. and J. FERNANDEZ.

PART IV.

(*Continued from page* 171 *of this volume*).

(*With* 3 *plates*).

BIGNONIACEAE.

800 species.—Tropics.

TECOMELLA Seem.

1 species.—Arabia, S.-W. Asia.

Tecomella undulata Seem in Ann. & Mag. Nat. Hist. ser. 3, x, 30.
Vernacular name: Regdawan (Pu.); Whira (Hind.); Ribdhvan (Waziri); Ribdunh (Mashudi).
Locality: *N.W.*: Shewa Post, on rocky bank (B. & F. 927 !).—Dwa Warkha, abundant (Stewart); Isha (B. & F. 927a !).
S.W.: Sararogha (F. 1 ! 15 ! 577 !).—Sarwekai (F. 1464 !).—Jandola (F. 4129 !).—Near Palosina (Stewart).—Barwand, 4,000 ft. (Duthie's Collect. 15637 !).
Flowers: April 1860 (Palosina, Dwa Warkha); 5-4-30 (Shewa Post); 28-4-1895 (Barwand); 15-5-27 (Sararogha).
Distribution: Punjab, Rajputana Desert, Sind, Baluchistan to Arabia.

*TECOMA Juss.

90 species.—Tropical and warm temperate regions.

***Tecoma sp.**
Locality: *N.W.*: Miram Shah, garden, 3,150 ft. (B. & F. 39a !, F. 2365 !).
Flowers: 19-3-30 (Miram Shah); 12-4-27 (Miram Shah).

*CATALPA Scop.

10 species.—America, E. Asia.

***Catalpa speciosa** Warder ex Engelm. in Coult. Bot. Gaz. v (1880) 1.
Vernacular name: Hardy Catalpa.
Locality: *N.W.*: Miram Shah (B. & F. 45 !).
Distribution: Indigenous in the United States.

ACANTHACEAE.

2,000 species.—Especially tropics, but also Mediterranean, United States, Australia.

HYGROPHILA R. Br.

40 species.—Tropics, in marshes.

Hygrophila polysperma T. Anders. in Journ. Linn. Soc. ix (1867) 456.
Locality: *S.W.*: Jandola, along Tank River (F. 789 !).
Distribution: Afghanistan, throughout India in wet places.

LEPIDAGATHIS Willd.

80 species.—Tropics.

Lepidagathis calycina Hochst. ex DC. Prodr. xi (1847) 252.—*L. strobilifera* Stocks in Kew Journ. Bot. iv (1852) 177.

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Locality: *S.W.*: Sararogha, in nala along slopes (F. 8 ! 9 ! 13 !)—Jandola (F. 240 ! 258 ! 274 !).
Flowers: 16-5-27 (Sararogha); 27-5-27 (Jandola).
Distribution: Sind, Baluchistan, Abyssinia.

Lepidagathis sp.—No flowers, no fruit. A stunted perennial. Leaves obovate, acute or cuspidate.
Locality: *S.W.*: Jandola, along Tank River (F. 708 !).

ADHATODA Tourn. ex Medic.

100 species.—Tropics.

Adhatoda vasica Nees in Wall. Pl. As. Rar. iii, 103.
Locality: *N.W.*: Spinwam, forming a pure formation on conglomerate ridge W. of Fort (B. & F. 429 !).
Distribution: Almost throughout India, Malaya, S.-E. Asia.

DICLIPTERA Juss.

100 species.—Tropics and subtropics.

Diclíptera Roxburghiana Nees in Wall. Pl. As. Rar. iii, 111, **var. bupleuroides** C. B. Clarke.
Locality: *N.W.*: Razani (Stewart).
S.W.: (Duthie's Collect. 15638 !).
Flowers: October 1860 (Razani).
Distribution: Throughout India in the hills, 1,000-6,000 ft., Himalayas, Central India, Afghanistan.

VERBENACEAE.

750 species.—Almost all tropical and subtropical.

LANTANA L.

60 species.—Tropics and subtropics.

Lantana indica Roxb. Hort. Beng. 46.
Locality: *N.W.*: Dwa Warkha (Stewart).
Distribution: Throughout India, Baluchistan, tropical Africa.

LIPPIA Houst. ex L.

120 species.—Mostly tropical America, Africa.

Lippia nodiflora Rich. in Michx. Fl. Bor. Am. ii, 15.
Locality: *N.W.*: Khaisora River (Stewart).—Chasmai River, near Miram Shah, 3,100 ft. (B. & F. 315 !).—Shewa Post, right bank of Kuram River (B. & F. 925 !).—Miram Shah (F. 870 !).
S.W.: Sarwekai (F. 3654 !).—Jandola (F. 759 !).—Spin (F. 3543 !).
Tank: (Duthie's Collect. 15764 !, J. Williams 7186 !).
Flowers: 16-4-27 (Miram Shah); 12-6-27 (Sarwekai); 21-6-27 (Spin).
Distribution: All tropical and warm temperate regions.

VERBENA L.

100 species.—Tropical and temperate regions.

Verbena officinalis L. Sp. Pl. 20.
Locality: *N.W.*: Dwa Warkha (Stewart).
Tank: (Duthie's Collect. 15732 !).
Distribution: Himalaya up to 6,000 ft., from Kashmir to Bhutan, temperate and tropical regions.

VITEX Tourn. ex L.

75 species.—Tropical and temperate regions.

Vitex negundo L. Sp. Pl. (1753) 638.
Vernacular name: Marivande (Pu.); Warmandai (Waziri).

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Locality: *N.W.*: Dwa Warkha, abundant (Stewart).—Spinwam (Stewart).—Near Datta Khel village, forming a rough hedge along water channel, 4,600 ft. (B. & F. 1435 !).

S.W.: Above Khirgi, groves frequent along the edges of the ravine (Stewart).—N. of Doboi, 5,000 ft., in damp places (Stewart).

Flowers: April, May.

Distribution: Throughout India and in Ceylon, N.-W. Himalaya up to 5,000 ft., Baluchistan, Afghanistan, extending to tropical Africa and Madagascar, and to China and the Philippines.

Vitex agnus castus L. Sp. Pl. 890.

Vernacular name: Marmandai (Mashudi).

Locality: *N.W.*: Boya, right bank of Tochi River, on sandy clay, 3,550 ft. (B. & F. 1682 !).—Below Spinwam Fort, along nala, 2,650 ft. (B. & F. 432 !).

S.W.: Sararogha (F. 2 ! 36 ! 188 ! 208 !).—Jandola, open stony ground and nalas (F. 644 ! 649 !).

Flowers & Fruit: 27-3-30 (Spinwam); 21-4-30 (Boya); 15-5-27 (Sararogha); 24-5-27 (Jandola).

Distribution: Baluchistan, Afghanistan, W. Asia, Mediterranean.

PLANTAGINACEAE.

About 200 species.—Cosmopolitan.

PLANTAGO (Tourn.) L.

200 species.—Cosmopolitan.

Plantago saxatilis M. Bieb. Taur. Cauc. i, 109.

Vernacular name: Khatakai.

Locality: *N.W.*: Boya, along irrigation channel, 3,550 ft. (F. 1155 ! 1155a !).—Boya Fort, on sand (B. & F. 78 !).—Miram Shah, 3,150 ft. (B. & F. 36 !).

S.W.: N. of Razmak Camp, 6,600 ft. (B. & F. 1255 !).

Flowers & Fruit: 19-3-30 (Miram Shah); 21-3-30 (Boya); 5-4-27 (Boya); 14-4-30 (Razmak).

Distribution: Macedonia, Orient, Persia.

Plantago amplexicaulis Cav. Ic. ii, 22, t. 125.

Locality: *N.W.*: Pigeons' Cave, on hill E. of Miram Shah Fort, 3,600 ft. (B. & F. 540 ! 552 !).

Flowers & Fruit: 29-3-30.

Distribution: Punjab Plains, Malva, Sind, Baluchistan, Afghanistan, westwards to Greece and Egypt.

Plantago amplexicaulis Cav. Ic. ii, 22, t. 125, **var. bauphula** (Edgew.) Pilger.—*P. Bauphula* Edgew. in Hook. Journ. Bot. ii (1840) 285.

Vernacular name: Isafgul.

Locality: *N.W.*: Pigeons' Cave, on a hill E. of Miram Shah Fort, 3,600 ft. (B. & F. 540 ! 552 !).

S.W.: In the lower regions (Stewart).

Tank: (J. Williams 7189).

Flowers: 5-5-1888 (Tank); September 1860 (S.W.).

Distribution of type.

Uses: Seeds used in dysentery (Williams).

Plantago ovata Forsk. Fl. Aegypt.-Arab. (1775) 31.—*P. Ispaghula* Roxb. Fl. Ind. i (1832) 404.

Locality: *N.W.*: Left bank of Chasmai River, 3,100 ft. (B. & F. 301 !).—Sandy clay E. of Miram Shah, 3,150 ft. (B. & F. 151 !).—Bed of Sua Algad, near Khajuri Post, 2,250 ft. (B. & F. 359 !).—Shewa Post, on sand and gravel, 2,150 ft. (B. & F. 938 !).—Tochi River near Miram Shah (F. 364 !).—At Boya, on gravel, 3,550 ft. (B. & F. 1691 !).—Miram Shah, on gravel, 3,150 ft. (B. & F. 482 !, F. 449 !).

Flowers & Fruit: 24-3-30 (Chasmai River); 26-3-30 (Khajuri Post); 28-3-30 (Miram Shah); 5-4-30 (Shewa Post); 12-4-27 (Miram Shah); 14-4-27 (Tochi River); 21-4-30 (Boya).

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Distribution: N.-W. India, Sind, Turkestan, Persia, westwards to Spain and the Canaries.

Plantago Loeflingii L. Sp. Pl. (1753) 166.
Locality: *N.W.*: E. of Spinwam Fort, in sandstone nala, 2,650 ft. (B. & F. 677 !).—Plain W. of Spinwam Fort, on gravel, 2,650 ft. (B. & F. 853 !).—Miram Shah (F. 312 !).
Flowers & Fruit: 1-4-30 (Spinwam); 4-4-30 (Spinwam); 16-4-27 (Miram Shah).
Distribution: Persia, Caucasus, Mesopotamia, Syria, N. Africa, Canaries, Spain.

Plantago coronopus L. Sp. Pl. (1753) 166, **var. filiformis** (Koch) Muschler Fl. Egypt ii, 912.—*P. coronopus var. simplex* Boiss. Fl. Or. iv, 888.
Vernacular name: Khatakai.
Locality: *N.W.*: Razani (F. 2173 !).
Flowers & Fruit: 23-4-27 (Razani).
Distribution of var.: Persia, Transcaucasus, Mesopotamia, Egypt.

Plantago ciliata Desf. Fl. Atl. i, 137, t. 39.—*P. eriantha* Dcne. in DC. Prodr. xiii, 1, 708.
Vernacular name: Haidar boti (Williams); Kharbita (Waziri).
Locality: *N.W.*: In the lower regions (Stewart).—9 miles from Spinwam (B. & F. 690 !).—Sandstone nala E. of Spinwam Fort (B. & F. 654 !).—Miram Shah, on stony ground (B. & F. 319 !).—On boulder-strewn slope of Chota Darweshta, W. of Spinwam Fort, 3,000-4,800 ft. (B. & F. 695 ! 752 !).—On disintegrating limestone hills N. of Spinwam Fort (B. & F. 812 !).—Left bank of Volam River below Shewa Post (B. & F. 873 ! 891a !).—Plain W. of Spinwam on gravel (B. & F. 852 !).—Bed of Kuram River near Shewa Post (B. & F. 950 !).—Spinwam Fort, 2,600 ft. (B. & F. 775 ! 810 !).—Right bank of Sua Algad at Khajuri Post, 2,250 ft. (B. & F. 357 !).
Tank: Near Tank, Shaur Hill (J. Williams !).
Flowers: 29-5-1891 (Tank).
Flowers & Fruit: 26-3-30 (Khajuri Post); 1-4-30 (Spinwam); 2-4-30 (Chota Darweshta); 4-4-30 (Spinwam); 5-4-30 (Shewa Post); 16-4-27 (Miram Shah).
Distribution: Punjab Hills, Salt Range, Orient, Egypt.

Plantago Lagopus L. Sp. Pl. (1753) 165.
Locality: *N.W.*: Razani (F. 2193 ! 2195 !).—Datta Khel, along water channel in garden, 4,600 ft. (B. & F. 1,400 !).—Datta Khel, on gravel along irrigation channel, 4,600 ft. (B. & F. 1399 ! 1463 !).—Boya Fort, 3,550 ft. (B. & F. 116 !).
S.W.: N. of Razmak Camp, below Springs, 7,700 ft. (B. & F. 1822 !).—Razmak, below Springs (B. & F. 1821 !).—Hills S.-W. of Razmak, 6,950 ft. (B. & F. 1934 !).
Flowers & Fruit: 21-3-30 (Boya); 17-4-30 (Datta Khel); 23-4-27 (Razani); 25-4-30 (Razmak); 27-4-30 (Razmak).
Distribution: Orient, Mediterranean.

Plantago lanceolata L. Sp. Pl. 113.
Vernacular name: Shekai para.
Locality: *N.W.*: Dwa Warkha (Stewart).—5,000-8,000 ft. (Stewart).—Shakai, 6,000-7,000 ft. (Duthie's Collect. 15691 !).
S.W.: Pre Ghal (J. Williams 7957 !).
Flowers: 30-4-1895 (Shakai).
Distribution: W. Himalaya, Salt Range, Europe, N. Asia.

Plantago lanceolata L. forma genuina Boiss.
Locality: *N.W.*: Datta Khel, along water channels (F. 1278 !).
S.W.: Wana Plain, in marshes (F. 3488 !).—Razmak, on slope of hill (B. & F. 1933 !).
Flowers & Fruit: 25-3-27 (Datta Khel); 27-4-30 (Razmak); 16-6-27 (Wana).

Plantago lanceolata L. forma altissima Dcne. in DC. Prodr. xiii, 1, 714.
Locality: *N.W.*: S. of Miram Shah village, in river-bed of sand and gravel (B. & F. 508 !).—Miram Shah (F. 811 !).—Datta Khel village (B. & F. !).—Chasmai River, in clayey sand, 3,100 ft. (B. & F. 240 ! 240b !).—

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From Boya to Datta Khel, along water channel, 4,500 ft. (B. & F. 590 !).—Near Spinwam Fort, in bed of Kaitu River (B. & F. 442 !).

S.W.: Slope of hill E. of Razmak, above 6,800 ft. (B. & F. 1923 !, F. 2010 !).

Flowers: 23-3-30 (Chasmai River); 27-3-30 (Spinwam); 28-3-30 (Miram Shah); 30-3-30 (Boya to Datta Khel); 16-4-27 (Miram Shah); 26-4-30 (Razmak); 30-4-27 (Razmak).

Distribution of form: Afghanistan, Caucasus, Greece, *alibi*.

Plantago lanceolata L. forma longe-cylindrica Blatter.

Spicae angustae, cylindricae, 3.5 cm. longae; pedunculi foliis triplo longiores.

Vernacular name: Khatakai (Waziri).

Locality: *N.W.*: N. of Miram Shah village, on clay banks of irrigation channel, 3,150 ft. (B. & F. 465 !, F. 852 !).—Razani (F. 2183 !).—Datta Khel Fort, in garden along water channel, 4,600 ft. (B. & F. 1401 !).

Flowers & Fruit: 28-3-30 (Miram Shah); 16-4-27 (Miram Shah); 17-4-30 (Datta Khel); 23-4-27 (Razani); 18-5-27 (Sararogha).

Plantago lanceolata L. forma lagopiformis Blatter.

Habet habitum vegetativum Pl. lagopi.

Vernacular name: Zundunh, Khatakai (Waziri).

Locality: *N.W.*: Datta Khel Fort, under trees (B. & F. 591 !).—Above Chasmai River, in cultivation (B. & F. 339 !).—Boya (F. 999 !).

S.W.: W. of Razmak, on gravel plain, 6,800 ft. (B. & F. 1729 !).—Razmak (F. 2303 ! 3164 !).

Flowers: 24-3-30 (Chasmai River); 28-3-27 (Boya); 30-3-30 (Datta Khel); 24-4-30 (Razmak); 5-5-27 (Razmak).

Plantago lanceolata L. forma brevifolia Blatter.

Folia multo breviora et angustiora, spicae ovatae vel oblongae.

Vernacular name: Pevra (Waziri).

Locality: *N.W.*: Bed of Tochi River at Miram Shah village, on gravel and sand, 3,150 ft. (B. & F. 510 !).—Datta Khel village, on clay bank of water channel, 4,600 ft. (B. & F. 1495 !, F. 1277 ! 1309 !).—Razani (F. 2620 !).

Flowers: 25-3-27 (Datta Khel); 28-3-30 (Tochi River); 17-4-30 (Datta Khel); 25-4-27 (Razani).

Plantago lusitanica Willd. Sp. Pl. i, 644; Dene. in Dc. Prodr. xiii (1852), pt. 1, 716.—*P. Lagopus* L. *var. major* Boiss. Fl. Or. iv, 886.—*P. lagopus* L. *var. lusitanica* Muschler Fl. Egypt ii, 910.

Boiss. l.c has put *P. lusitanica* Willd. as a variety under *P. Lagopus* L. and Muschler has followed him. I think this was an oversight, as will be clear to everybody who carefully reads the descriptions in Decaisne (DC. Prodr. l.c.). Our specimen shows the leaves 5-7-nerved.

Locality: *N.W.*: Razani (F. 2209 ! 2833 !).

S.W.: N. of Razmak below Springs, 7,700 ft. (B. & F. 1256 ! 1823 !).—Slope of Shuidar, in meadow, 7,500-8,000 ft., together with *Rumex* (F. 1583 !).

Flowers: 14-4-30 (Razmak); 18-4-30 (Shuidar); 16-4-27 (Razani); 23-4-27 (Razani); 25-4-30 (Razmak).

Distribution: Mesopotamia, Syria, Mediterranean.

Plantago major L. Sp. Pl. 112.

Vernacular name: Gozi.

Locality: *S.W.*: Near Kanigram brook (Stewart).—Pre Ghal (J. Williams 7910 !).

Flowers: 2-8-1888 (Pre Ghal); September 1860 (Kaniguram).

Distribution: Temperate and alpine Himalaya up to 12,000 ft., Konkan, Deccan, Nilgiris, Ceylon, Assam, Khasia Hills, Burma, Malay Peninsula, Afghanistan, westwards to the Atlantic.

Plantago major var. brevis Pilger.

Locality: *Tank*: Near Tank (J. Williams 9225 !).

Fruit: 30-7-1888 (Tank).

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NYCTAGINACEAE.

160 species.—Mostly tropical and especially American.

Boerhavia Vaill. ex L.

40 species.—Cosmopolitan.

Boerhavia diffusa L. Sp. Pl. (1753) 3.—*B. procumbens* Roxb. Fl. Ind. i (1832) 146.

Vernacular name: Sussasir.

Locality: *N.W.*: Razani (Stewart).—Miram Shah, open stony plain (F. 327 ! 462 !).—Miram Shah, Tochi River (F. 361 !).—Khajuri Post, left bank of Sua Algad, 2,250 ft. (B. & F. 392 !).—E. of Spinwam Fort, nearest sandstone ridge, 2,800 ft. (B. & F. 780 !).—W. of Spinwam Fort, gravel plain, 2,650 ft. (B. & F. 855 !).

S.W.: Near Palosina (Stewart).—Razmak, stony plain (F. 2649 !).—Spin (F. 3536 !).

Tank: (J. Williams 7190 !).

Flowers & Fruit: 26-3-30 (Khajuri); April 1860 (Palosina, Razani); 4-5-1888 (Tank).

Distribution: Throughout India, Ceylon, tropical and subtropical Asia, Africa and America.

Boerhavia verticillata Poir. Encycl. Méth. v (1804) 56.

Locality: *N.W.*: W. of Spinwam Fort, gravel plain, 2,650 ft. (B. & F. 834 !).

Flowers: 4-4-30 (Spinwam Fort).

Distribution: Punjab, W. Peninsula, Baluchistan, Afghanistan, to Syria and tropical Africa.

Boerhavia repanda Willd. Sp. Pl. i (1797) 22.

Locality: *S.W.*: Sararogha, dry nalas (F. 6 ! 227 ! 611 !).—Jandola, open stony ground and nalas (F. 625 ! 632 !).—Along Tank River (F. 728 !).—Spin (F. 3534 !).

Flowers & Fruit: 21-5-27 (Sararogha); 21-6-27 (Spin).

Distribution: Baluchistan, Upper Gangetic plain and Rohilkhand, Konkan, Mysore, Travancore, Carnatic, Burma.

ILLECEBRACEAE.

About 70 species.—Most warm dry regions.

Herniaria (Tourn.) L.

20 species.—Mediterranean, Europe, S. Africa.

Herniaria hirsuta L. Sp. Pl. 218.

Vernacular name: Meravarki.

Locality: *Tank*: Near Tank, Shaur Hill (J. Williams !).

Flowers: 31-4-1891 (Tank).

Distribution: W. Himalaya, 4,000-8,000 ft., Punjab, Orient, westwards to the Atlantic.

Cometes L.

2 species.—W. Asia, Abyssinia.

Cometes surattensis Burm. Fl. Ind. 39, t. 15, f. 5.

Locality: Waziristan (ex Annendale & Carter p. 286).

Distribution: Sind, Baluchistan, Orient to S. Arabia.

AMARANTACEAE

700 species.—Tropical and temperate regions.

Amaranthus L.

60 species.—Tropical and temperate regions.

***Amaranthus Blitum L. var. oleracea** Hook. f. Fl. Brit. Ind. iv (1885) 721.

Locality: *N.W.*: Miram Shah, in garden (B. & F. 636 !).

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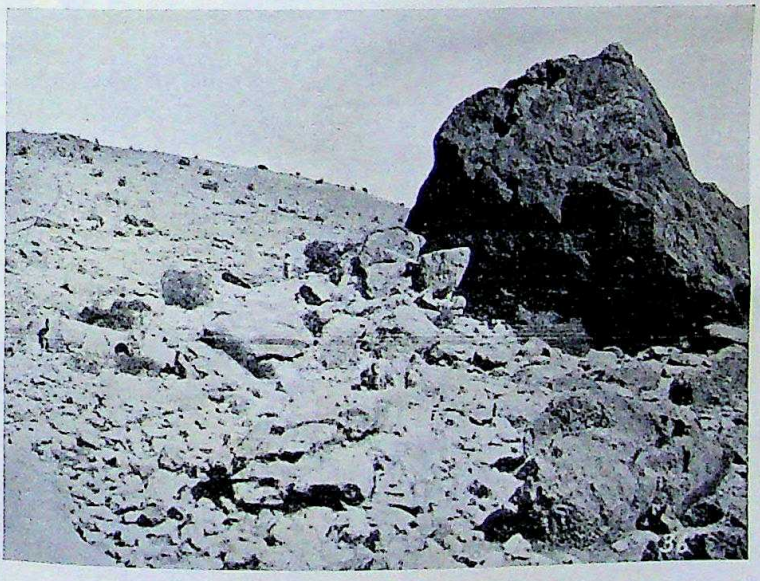
14. Looking W.N.W. from the hill-range E. of Miram Shah Fort with Afghan hills in the distance.



15. Lower slopes of Chota Darweshta W. of Spinwam Fort. Huge boulders with gravel.

Photos by J. Fernandez.

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Flowers: 31-3-30 (Miram Shah).
Distribution: Cultivated in India and elsewhere in warm regions.

Amaranthus paniculatus L. Sp. Pl. ed. ii, 1406.
Vernacular name: Darvadhang (Waziri).
Locality: *S.W.*: Slope of Shuidar, in terrassed field, 7,000-9,000 ft., plant of previous year (F. 1575 !).—Razmak (F. 2517 ! 2519 !).
Distribution: Cultivated or an escape in E. and W. Asia and Africa.

Amaranthus viridis L. Sp. Pl. (1753) 1405.
Locality: *N.W.*: Miram Shah, in garden (B. & F. 641 !).
Flowers & Fruit: 31-3-30 (Miram Shah).
Distribution: All tropical countries.

Pupalia Juss.

7 species.—Africa, Madagascar, Asia.

Pupalia lappacea Moq. in DC. Prodr. xiii, 2, 331.
Locality: *N.W.*: In the plains (Stewart).
Tank: Near Tank (J. Williams 7912 !).
Flowers: 25-6-1888 (Tank).
Distribution: W. tropical Himalaya, 1,000-3,000 ft., from Kashmir to Kumaon, Punjab, Deccan, tropical Asia and Africa.

Aerua Forsk.

12 species.—Tropical Asia, Africa.

Aerua tomentosa Forsk. Fl. Aeg.-Arab. (1775) n. 534, *et* p. 170.—*A. javanica* Juss. in Ann. Mus. Par. ii (1803) 131.
Vernacular name: Ganderai, Khadavana (Waziri).
Locality: *N.W.*: Dwa Warkha (Stewart).—Slope of Chota Darweshta, W. of Spinwam Fort, 2,700-3,000 ft. (B. & F. 716 !).—Miram Shah (F. 943 ! 987 ! 990 !).—E. of Spinwam Fort, nearest sandstone ridge, 2,800 ft. (B. & F. 778 !).
S.W.: Nilikach, Gomal Pass (Duthie's Collect. 15736 !).—Sararogha (F. 45 ! 59 ! 80 !).—Jandola (F. 261 ! 4138 !), along Tank River (F. 693 ! 707 ! 716 ! 4107 !).—Sarwekai (F. 3997 ! 4005 !).—Tenai Post (F. 3793 !).—Tenai, on stony plain (F. 3813 !).
Tank: (Stewart, J. Williams 7192 !).
In bud: 21-6-27 (Tenai).
Flowers & Fruit: 13-4-27 (Miram Shah); April 1860 (Tank); 1-5-1888 (Tank); 18-5-27 (Sararogha); 27-5-27 (Jandola); 8-6-27 (Sarwekai).
Fruit: 23-5-1895 (Gomal Pass).
Distribution: India, Ceylon, Arabia, tropical Africa, Cape de Verde Islands.

Aerua tomentosa Forsk. **var. Bovei** (Webb) C. B. Clarke in Fl. Trop. Afr. vi, 1 (1909) 38.—*A. javanica var. Bovei* Webb in Boiss. Fl. Or. iv, 993.
Vernacular name: Spinkhadai (Waziri).
Locality: *N.W.*: Spinwam, on stony ground at foot of hill to the E., 2,600 ft. (B. & F. 759 !).
Distribution: Afghanistan, Baluchistan, Arabia, Egypt.

Aerua pseudo-tomentosa Blatter & Hall. in Journ. Bomb. Nat. Hist. Soc. xxvi (1919) 817.
Locality: *N.W.*: N. of Spinwam Fort on desintegrating limestone hill, 2,650 ft. (B. & F. 826 !).—Near Khajuri, slope of ridge along left bank of Sua Algad, 2,250 ft. (B. & F. 386 !).
Flowers: 26-3-30 (Khajuri); 4-4-30 (Spinwam).
Distribution: Jodhpur and Jaisalmer States.

Aerua lanata Juss. in Ann. Mus. Par. ii (1803) 131.
Vernacular name: Kharbita.
Locality: *N.W.*: E. of Spinwam Fort, on hill, 2,900 ft., fairly common (B. & F. 777 !).—N. of Spinwam, on limestone hill, 2,650 ft. (B. & F. 830 ! 831 !).—Miram Shah (F. 341 ! 348 ! 354 ! 949 !).
S.W.: Spin, open stony plain (F. 3530 ! 3829 ! 3855 ! 3870 !).

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In bud: 3-4-30 (Spinwam); 16-4-27 (Miram Shah).
Flowers & Fruit: 21-6-27 (Spin).
Distribution: Throughout India, Ceylon, Baluchistan, Arabia, tropical Africa, Java, Philippines.

ACHYRANTHES L.

15 species.—Tropics and subtropics.

Achyranthes aspera L. Sp. Pl. (1753) 204.
Vernacular name: Uput kanda (Williams).
Locality: *N.W.*: Dwa Warkha (Stewart).
S.W.: Sararogha (F. 235 !).—Jandola, along dry banks of Tank River (F. 777 !).
Tank: (J. Williams 7194 !).
Flowers: 4-5-1888 (Tank); 21-5-27 (Sararogha); 25-5-27 (Jandola); Oct. 1860 (Dwa Warkha).
Distribution: Tropics generally.
Uses: Flowers used as a cathartic in children (Williams).

CHENOPODIACEAE.

500 species.—Natives of all climates as nearly all are halophytic.

CHENOPODIUM (Tourn.) L.

60 species.—All climates.

Chenopodium album L. Sp. Pl. (1753) 219.
Vernacular name: Ganar, Surmai (Waziri).
Locality: *N.W.*: Dwa Warkha (Stewart).—Near Datta Khel along irrigation channel, 4,600 ft. (B. & F. 1440 !).—Datta Khel village, nala, 4,600 ft. (B. & F. 1356 ! 1411 ! 1412 ! 1489 !).—Near Miram Shah village, bed of Tochi River, in gravel and sand (B. & F. 493 !).—E. of Miram Shah, sandy plain, 3,150 ft. (B. & F. 132 !).—Near Miram Shah, right bank of Chasmai River (B. & F. 288 !).—Spinwam Fort, 2,650 ft. (B. & F. 440 ! 666 ! 790 ! 865 !).—Dossali Fort, 4,900 ft. (B. & F. 1301 !).
S.W.: N. of Razmak, 7,700 ft. (B. & F. 1848 !).—Sararogha, 5,000 ft. (F. 140 ! 616 !).—Wana (F. 3131 !).
Tank: (J. Williams 7195 !).
Flowers: 27-3-30 (Spinwam); 28-3-30 (Miram Shah village); 17-4-30 (Datta Khel); 4-5-1888 (Tank).
Distribution: Tropical and temperate Himalaya, from Kashmir to Sikkim up to 14,000 ft., Punjab, Baluchistan, cosmopolitan.

Chenopodium opulifolium Schrad. in DC. Fl. Franc. 5 (1805) 372.
Locality: *N.W.*: Dossali Fort, left bank of Khaisora River, 4,900 ft. (B. & F. 1160 ! 1167 !).
Flowers & Fruit: 13-4-30 (Dossali Fort).
Distribution: Central and W. Himalaya, N. and W. Asia, Europe, Mediterranean.

Chenopodium hybridum L. Sp. Pl. (1753) 219.
Locality: *N.W.*: Dwa Warkha (Stewart).
Distribution: W. Himalaya, 12,000 ft., Punjab, Baluchistan, Europe, N. Africa, N. Asia.

Chenopodium murale L. Sp. Pl. (1753) 219.
Vernacular name: Thormai (Waziri).
Locality: *N.W.*: Hills E. of Miram Shah Fort (B. & F. 560 !).—Miram Shah, garden, 3,150 ft. (B. & F. 639 !); Right bank of Chasmai River, 3,100 ft. (B. & F. 232 !).—Near Khajuri Post, bed of Sua Algad, 2,250 ft. (B. & F. 362 !).—W. of Spinwam Fort, 2,650 ft. (B. & F. 755 ! 857 !).
Flowers & Fruit: 29-3-30 (Miram Shah); 4-4-30 (Spinwam).
Distribution: Ubiquitous.

Chenopodium botrys L. Sp. Pl. (1753) 219.
Locality: *N.W.*: Boya, 3,550 ft. (B. & F. 1679 !).

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S.W.: Pre Ghal (Hay, J. Williams 7913 !).—N. of Doboi, above 5,000 ft. on a feeder of the Zam, abundant (Stewart).—Kundiwan, 5,500 ft. (Duthie's Collect. 157633 !).
Flowers: 21-4-30 (Boya); May 1860 (Kundiwan); 10-5-1895 (Kundiwan).
Distribution: W. Himalaya, 4,000-14,000 ft., Punjab, Orient, N. Africa.

Chenopodium foliosum (Moench.) Aschers. Fl. Prov. Brandenb. (1864) 572.—*Blitum virgatum* L. Sp. Pl. (1753) 4.
Vernacular name: Towe (Waziri).
Locality: *N.W.*: Razmak Narai, 7,250 ft. (B. & F. 1192 !).
S.W.: E. of Razmak, slope of hill, 6,800 ft. (B. & F. 1927 !).—Razmak (F. 2286).—Between Makin and Razmak (Stewart).
Tank: (J. Williams 9179 !).
Flowers & Fruit: 25-4-30 (Razmak); 7-5-27 (Razmak); 1-7-1888 (Tank).
Distribution: N.W. India, Turkestan, Siberia, Orient, Europe, N. Africa.

Chenopodium rubrum L. Sp. Pl. (1753) 218.—*Blitum polymorphum* C. A. Mey. in Led. Fl. Alt. i (1826) 13.
Locality: *N.W.*: Miram Shah Fort, garden, 3,150 ft. (B. & F. 626 !).
S.W.: S.W. of Razmak, 6,950 ft. (B. & F. 1935 !).
Flowers & Fruit: 31-3-30 (Miram Shah); 27-4-30 (Razmak).
Distribution: Siberia, Turkestan, Orient, Europe.

*Spinacia (Tourn.) L.

2 species.—E. Mediterranean.

*** Spinacia oleracea** L. Sp. Pl. (1753) 1027.
Locality: *N.W.*: Miram Shah village, 3,150 ft., cultivated (B. & F. 491 !).
Flowers & Fruit: 28-3-30.
Distribution: Cultivated everywhere.

Atriplex (Tourn.) L.

180 species.—Temperate and subtropical regions.

Atriplex crassifolia C. A. Mey. in Led. Fl. Alt. iv, 309.
Locality: *N.W.*: Khaisora (Stewart).—Near Khajuri Post, right bank of Sua Algad, 2,250 ft. (B. & F. 358 !).
Distribution: N. W. India and the Punjab, 8,000-12,000 ft., Afghanistan, Turkestan, Soongaria, Altai Mts.

Atriplex Stocksii Boiss. Diagn. ser. ii, no. 4 (1859) 73.
Locality: *N.W.*: E. of Spinwam Fort, sandstone nala, 2,650 ft. (B. & F. 681 !).
Distribution: Gujarat, Kathiawar, Sind.

Atriplex hastata L. Sp. Pl. (1753) 1053.
Vernacular name: Vorogo titkai (Waziri).
Locality: *S.W.*: E. of Razmak Camp, 6,800 ft. (B. & F. 1737 ! 1903 !, F. 2404 !).
Flowers & Fruit: 2-5-27 (Razmak); 25-4-30 (Razmak).
Distribution: Siberia, Afghanistan, Orient, Mediterranean, Europe.

Atriplex Belangeri Moq. in DC. Prodr. xiii, 108.
Locality: *N.W.*: Miram Shah village, old torrent bed, 3,150 ft. (B. & F. 513 !).—Plain W. of Spinwam Fort, 2,650 ft. (B. & F. 866 !).
Distribution: Afghanistan, Persia.

Atriplex farinosa Forsk. Fl. Aeg.-Arab. (1775) cxxiii, no. 302.
Locality: *S.W.*: Wana, common, 5,000 ft. (F. 3465 !).
Flowers: 16-6-27 (Wana).
Distribution: Brit. E. Africa, Nubia, Egypt, Arabia, Petraea, tropical Arabia.

Atriplex affinis leucoclado Boiss.
Locality: *S.W.*: Sarwekai (F. 3900 !).—Spin, open stony plain (F. 3859 !).

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EUROTIA Adans.

2 species.—Mediterranean, W. Asia, N. America.

Eurotia ceratoides (L.) C. A. Mey. in Led. Fl. Alt. iv (1833) 239.—*Axyris ceratoides* L. Sp. Pl. (1753) 979.
Locality: *N.W.*: Khajuri Post, right bank of Sua Algad, on gravel, 2,250 ft. (B. & F. 350 !).
Distribution: W. Himalaya, 8,000-14,000 ft., Central Asia, Siberia, Mongolia, Afghanistan, Europe, Mediterranean.

KOCHIA Roth.

35 species.—N. temperate regions, Australia, S. Africa.

Kochia prostrata (L.) Schrad. Neues Journ. iii, 3, 4 (1809) 85.
Locality: *N.W.*: E. of Datta Khel Fort, stony plain, 4,600 ft. (B. & F. 1375 !).
S.W.: Spin, open stony plain (F. 3843 !).—Wana, 5,000 ft. (F. 3499 !).
Distribution: W. Himalaya, 10,000-14,000 ft., Central Asia, Siberia, westwards to Spain and N. Africa.

Kochia stellaris Moq.-Tand. Chenop. Monogr. Enum. (1840) 93.—*K. odontoptera* Schrenk. in Bull. Acad. Petersb. i (1843) 361.
Locality: Lower zone (Stewart).
Distribution: W. Tibet, 8,000-12,000 ft., Afghanistan, Baluchistan, Turkestan, Persia.

SUAEDA Forsk.

40 species.—Cosmopolitan, on seacoast and in salt steppes.

Suaeda fruticosa Forsk. Fl. Aeg.-Arab. (1775) 70.
Vernacular name: Kali sauri (Williams).
Locality: *N.W.*: Khajuri Post, left bank of Tochi River, 2,250 ft. (B. & F. 415 !).
Tank: (J. Williams 7198 !).
Flowers: 26-3-30 (Khajuri); 4-5-1888 (Tank).
Distribution: N.W. India, westwards to the Atlantic, Africa, America.
Uses: Camels eat it.

Suaeda monoica Forsk. Fl. Aeg.-Arab. (1775) 70.
Locality: *N.W.*: Khajuri Post, right bank of Sua Algad, on gravel, 2,250 ft. (B. & F. 349 !).
S.W.: Jandola (F. 3890 !).—Dargai Post (F. 3765 !).—Tenai (F. 4020 !).—Spin, open stony plain (F. 3541 ! 3835 !).
Distribution: S. India, Ceylon, Baluchistan, Arabia, tropical Africa.

Suaeda maritima (L.) Dumort. Fl. Belg. (1827) 22.—*Chenopodium maritimum* L. Sp. Pl. (1753) 221.
Locality: *S.W.*: Dargai Post (F. 3775 !).—Tenai (F. 4038 !).
Distribution: India, Ceylon, Siam, N. Asia, Orient, N. Africa, Europe, N. America.

Suaeda sp.
Locality: Waziristan (Duthie's Collect. 15730).

HALOXYLON Bunge.

10 species.—Mediterranean, Central Asia.

Haloxylon recurvum Bunge ex Boiss. Fl. Or. iv (1879) 949.
Locality: *N.W.*: 9 miles S. of Spinwam Fort (B. & F. 692 !).
S.W.: Spin, open stony plain (F. 3851 ! 3860 ! 3861 !).
Distribution: India, Afghanistan, Baluchistan, Yunnan.

Haloxylon salicornicum Bunge ex Boiss. Fl. Or. iv (1879) 949.
Vernacular name: Shurai, Karsussa, Nunai (Waziri).
Locality: *N.W.*: Datta Khel Fort, 4,500 ft. (B. & F. 608 !).—Plain N. of Boya Fort, clayey sand, 3,550 ft. (B. & F. 74 !).—Plain E. of Miram

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Shah Fort, gravel, also in water, 3,150 ft. (B. & F. 121 ! 129 ! 149 ! 484 !, F. 479 !).—Spinwam, hills, 2,650 ft. (B. & F. 763 !).
S.W.: Razmak (F. 1639 !).—Sarwekai (F. 3957 ! 3974 !).—Tenai Post (F. 3808 !).
Distribution: Punjab, Baluchistan, Afghanistan.

Haloxylon articulatum Boiss. Fl. Or. iv (1879) 949.
Vernacular name: Sherai (Waziri).
Locality: *N.W.*: Near Miram Shah Fort, right bank of Chasmai River, 3,100 ft. (B. & F. 234 !).
Distribution: Syria, tropical Arabia N. Africa, Mediterranean.

Haloxylon multiflorum Bunge in Boiss. Fl. Or. iv (1879) 949.
Vernacular name: Uch sarakai (Waziri), Sherakai (at Boya), Shurai (at Wana).
Locality: *N.W.*: Dwa Warkha (Stewart).—Datta Khel (F. 1182 !).—Boya, gravel (B. & F. 1481 ! 1671 !).—Miram Shah, open stony ground (F. 434 !).
S.W.: Wana, open stony ground (F. 3615 !).
Distribution: Afghanistan.

Haloxylon Griffithii Boiss. Fl. Or. iv (1879) 950.
Vernacular name: Sherai (Madda Khel and Khaddar Khel, Waziri), Shorai (by the Ahmadzai Waziri), Galmai (Waziri).
Locality: *N.W.*: Khaisora River (Stewart).—Datta Khel, 4,500 ft. (J. A. Robinson !).—Miram Shah (F. 817 !).
S.W.: Sarwekai (F. 3898 ! 3922 ! 3970 !).
Fruit: 3-11-29 (Datta Khel).
Distribution: Baluchistan, Afghanistan.

Salsola L.

40 species.—Cosmopolitan, maritime or on salt steppes.

Salsola Kali L. Sp. Pl. (1753) 222.
Locality: *N.W.*: In the lower regions (Stewart).
S.W.: Tenai Post, common on stony plain (F. 3792 ! 3795 !).—Spin, open stony plain (F. 3832 !).
Distribution: N.W. Punjab and Himalaya, 12,000-14,000 ft., westwards to the Atlantic, N. Asia, N. & S. Africa, N. America.

Salsola collina C. A. Mey. in Led. Fl. Alt. i, 393.
Locality: *N.W.*: Datta Khel Fort, 4,600 ft., specimen of previous year collected 17-4-30 (B. & F. 1410 !).
Distribution: Western Himalaya, 12,000-15,000 ft., Siberia, Soongaria, S. Russia.

Salsola foetida Del. Fl. d'Egypt (1813) 57.
Locality: *N.W.*: In the lower regions (Stewart).—Khajuri Post, hill on left bank of Sua Algad, 2,300 ft. (B. & F. 355 ! 381 ! 382 !).
S.W.: Jandola, open stony plain (F. 3897 !).—Dargai Post, stony slope (F. 3727 ! 4086 !).—Tenai (F. 4019 !).—Spin, open stony plain, common (F. 3542 ! 3849 !).
Distribution: Punjab Plains, Upper Gangetic Plain, Sind, Rajputana Desert, Baluchistan, Persia, Arabia, Africa.

Salsola verrucosa M. B. in Mem. Soc. Nat. Mosc. i (1811) 103.—*S. ericoides* C. A. Mey. Ind. Cauc. 160 (*non* M.B.).
Locality: *N.W.*: S. of Spinwam Fort, gravel plain (B. & F. 689 !).
S.W.: Spin, open stony plain (F. 3848 !).
Fruit: 1-4-30, of previous year (Spinwam).
Distribution: Persia, Orient, S.E. Russia.

Salsola tetrandra Forsk. Fl. Aeg.-Arab. (1775) 58.—*S. tetragona* Del. Fl. d'Eg. (1813) 204, tab. 22.
Locality: *N.W.*: S. of Spinwam Fort (B. & F. 691a !).
Distribution: Palestine, Arabia Petraea, Egypt, N. Africa.

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ANABASIS L.

20 species.—Mediterranean, Central Asia.

Anabasis phyllophora Kar. & Kir. Enum. Alt. (1841) no. 735.
Locality: *N.W.*: S. of Spinwam Fort (B. & F. 691 !).
Distribution: Punjab, Turkestan, Soongaria, Altai.

Anabasis setifera Moq. in Chenop. Enum. 164 *et* DC. Prodr. xiii, 2, 214.
Locality: *N.W.*: Khajuri Post, hill on left bank of Sua Algad, 2,450 ft. (B. & F. 396 !).
Distribution: Punjab, Salt Range, Persia, Arabia, Egypt.

HALOCHARIS Moq.

4 species.—W. Asia.

Halocharis violacea Bunge Anabas. Rev. 63, t. 1, f. 3.
Locality: *N.W.*: Dwa Warkha (Stewart).
Distribution: Punjab, Salt Range, Peshawar valley, Baluchistan, Afghanistan, S.E. Persia.

HALOGETON C. A. Mey.

5 species.—Mediterranean, Central Asia.

Halogeton glomeratus (M.B.) C. A. Mey. in Led. Fl. Alt. i (1829) 378.
Locality: *N.W.*: Datta Khel, garden, 4,600 ft. (B. & F. 1396 !).
Distribution: W. Tibet, 12,000-14,000 ft., Afghanistan, Turkestan, Siberia, Soongaria.

POLYGONACEAE.

750 species.—Chiefly N. temperate; a few tropical, arctic and southern.

CALLIGONUM L.

20 species.—N. Africa, W. Asia, S. Europe.

Calligonum polygonoides L. Sp. Pl. (1753) 530.
Locality: *Tank*: (J. Williams 7204 !).
Flowers: 5-5-1888 (Tank).
Distribution: Punjab, Salt Range, Baluchistan, Orient.

POLYGONUM (Tourn.) L.

275 species.—Cosmopolitan, but especially temperate.

Polygonum barbatum L. Sp. Pl. (1753) 362.
Locality: *N.W.*: Razani (Stewart).
Distribution: Throughout the tropics.

Polygonum plebejum Br. Prodr. 420.
Vernacular name: Chiradha.
Locality: *Tank* (J. Williams 7201 !).
Flowers: 4-5-1888 (Tank).
Distribution: Afghanistan, tropics of the Old World.

Polygonum aviculare L. Sp. Pl. (1753) 362.
Locality: *S.W.*: In the lower regions (Stewart).—Kaniguram, about 6,500 ft. (Stewart).
Tank: (J. Williams 7916 ! Stewart).
Flowers: April 1860 (Tank, Kaniguram); 21-6-1888 (Tank).
Distribution: Widely dispersed, indigenous in Europe and N. Asia.

Polygonum paronychioides C. A. Mey. in Bull. Soc. Nat. Mosc. (1898) 356: Meissn. in DC. Prodr. xiv, 1.—*P. Paronychia* C. A. Mey. Ind. cauc. 158 (*non* Cham. *et* Schlecht).
Locality: Tank (Duthie's Collect. 15634 !).
Flowers: 29-4-1895 (Tank).
Distribution: W. Himalaya, 8,000-12,000 ft., Afghanistan, Persia.

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Polygonum baldschuanicum Regel in Act. Hort. Petrop. viii (1884) 684, t. 10.
Locality: *S.W.*: Razmak, in garden (B. & F.).
Distribution: Bokhara.

Polygonum flaccidum Meissn. in DC. Prodr. xiv, 107 (*partim*).
Locality: *S.W.*: In the upper regions (Stewart).
Distribution: Common throughout India in wet places, Ceylon, Malacca, Malay Archipelago.

Polygonum sp.
Locality: Waziristan (Duthie's Collect. 15733).

RUMEX L.

100 species.—Especially N. temperate.

Rumex maritimus L. Sp. Pl. (1753) 335.—*R. acutus* Roxb. Fl. Ind. ii, 208.
Locality: Tank (Stewart).
Flowers: April 1860 (Tank).
Distribution: Marshes in Assam, Sylhet, Cachar and Bengal, Asia, Europe, N. Africa, S. America.

Rumex dentatus L. Mant. 226.
Vernacular name: Lablaba (Williams).
Locality: *S.W.*: Kaniguram, 6,500 ft. (Duthie's Collect. 15767 !).
Tank (J. Williams 7203 !).
Flowers: 13-5-1895 (Kaniguram); 14-5-1888 (Tank).
Distribution: N. India, Baluchistan, Afghanistan, Orient, Egypt.

Rumex dentatus L. Mant. 226, **var. pleiodon** Boiss. Fl. Or. iv, 1013.
Locality: *N.W.*: In garden at Miram Shah, 3,150 ft. (B. & F. 635 !).
Flowers: 31-3-30 (Miram Shah).

Rumex vesicarius L. Sp. Pl. (1753) 479.
Locality: *S.W.*: Near Palosina (Stewart).
Distribution: W. Punjab, Baluchistan, Afghanistan, Persia, the Levant, N. Africa.

LAURACEAE.

1,000 species.—Tropical and subtropical regions.

CASSYTHA L.

15 species.—Palaeotropics.

Cassytha filiformis L. Sp. Pl. (1753) 35.
Locality: *S.W.*: Razmak, riverbed, on *Berberis*, 6,750 ft. (B. & F. 54 !).
Flowers: 20-3-30 (Razmak).
Distribution: Tropics generally.

THYMELAEACEAE.

550 species.—Temperate regions and tropics, especially in Africa.

DAPHNE Tourn. ex L.

40 species.—Europe, temperate and subtropical Asia.

Daphne oleoides Schreb. Ic. Descr. Pl. Decad. i (1766) 13, t. 7; Brandis Ind. Trees (1911) 544; Parker For. Fl. Punj. (1918) 432.—*D. mucronata* Royle Ill. 322, t. 81, fig. 2; Brandis For. Fl. (1874) 384.—*D. acuminata* Boiss. & Hoh. Diagn. ser. 1, xii, 103; Boiss. Fl. Or. iv (1879) 1048.
Vernacular name: Laghinai, Pastavana (Waziri).
Locality: *N.W.*: Boya, on hills, S. of Boya Post, about 4,300 ft. (F. 1463 ! 1492 ! 1493 ! 1494 ! 1495 ! 1496 !).—Miram Shah, on hills, about 3,200 ft. (F. 1388 ! 1391 ! 1403 ! 1408 !).—Razani, common on hills, about 5,200 ft. (F. 2051 ! 2777 ! 2890 !).—Near Datta Khel (B. & F. 597 !).—Near Spinwam, Chota Darweshta, 4,800 ft. (B. & F. 737 !).—Dossali, stony plain, 4,900 ft. (B. & F. 998 ! 999 ! 1021 !).

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S.W.: Pre Ghal (Hay).—Above Anai Gorge, about 4,000 ft. (Stewart). —On wide shingle plateau of Tandachina (Stewart).—Razmak, open stony plain and on hills, 6,500 ft. (F. 1535 ! 1536 ! 1537 ! 1833 ! 2000 ! 2002 ! 2250 ! 2263 ! 2653 ! 2675 ! 2699 ! 2701 ! 2723 ! 2724 ! 2725 ! 3317 !).—Wana, scattered on plain, 4,500 ft. (F. 3454 ! 3461 !).—Barwand (Duthie's Collect. 15725 !).—Shuidar, 7,000-9,000 ft. (F. 1591 !).

Flowers: 30-3-30 (Datta Khel); 10-4-30 (Dossali); June.

Distribution: Mediterranean region, W. Asia, Afghanistan, Baluchistan, Kuram Valley to 11,000 ft., Himalaya as far east as the Jumna, 3,000-9,000 ft., Punjab.

THYMELAEA Tourn. ex Scop.

20 species.—Mediterranean, temperate Asia.

Thymelaea passerina (L.) Coss. *et* Germ. ex Fedtschenko *et* Fedtschenko Consp. Fl. Turk. vi (1916) 296.—*Stellera passerina* L. Sp. Pl. (1753) 559.—*Thymelaea arvensis* Lam. Fl. Fr. iii, 218.

Locality: *S.W.*: Lower regions (Stewart).

Flowers: April.

Distribution: Upper Punjab, Kashmir, Afghanistan, westwards to France and N. Africa.

ELAEAGNACEAE.

25 species.—Chiefly on steppes and coasts of N. hemispheres.

ELAEAGNUS (Tourn.) L.

20 species.—Asia, Europe, N. America.

Elaeagnus angustifolia L. Sp. Pl. ed. i (1753) 176; Fedtschenko & Fedtschenko Consp. Fl. Turk. pt. 6 (1916) 298.—*E. spinosa* L. Amoen. Acad. iv, 305.—*E. hortensis* M. Bieb. Fl. Taur.-Cauc. ii (1808) 112; Boiss. Fl. Or. iv (1879) 1056; Servettaz Monogr. des Eléagnacées in Beih. Bot. Centralbl. 2. Abt. xxv (1909) 33.

Locality: *N.W.*: Razani, planted, 5,000 ft. (F. 2210 ! 2213 ! 2218 ! 2227 ! 2775 ! 2776 ! 2782 !).—Miram Shah, 3,000 ft. (F. 1078 !).

S.W.: Wana, planted, 4,500 ft. (F. 3664 ! 3672 ! 3674 !).—Razmak, 6,500 ft. (F. 2779 !).

Elaeagnus umbellata Thunb. Fl. Jap. 66, t. 14; Brandis Ind. Trees (1911) 547; Parker For. Fl. (1918) 434.—*E. parvifolia* Wall. Cat. 4026; Royle Ill. 323, t. 81, f. 1.

Vernacular name: Sanzela (Waziri).

Locality: *N.W.*: Boya, 4,000 ft. (F. 894 ! 1370 ! 1371 ! 1372 ! 1373 ! 1374 !).—Miram Shah, 3,000 ft. (F. 1085 ! 1086 !, B. & F. 511 !).

S.W.: Wana, S.E. of Camp, 4,500 ft. (F. 3602 ! 3634 ! 3675 !). All the specimens from planted trees.

Flowers: April.

Distribution: Kuram Valley, Himalaya, 3,000-10,000 ft., Manipur, China, Japan.

Uses: Fruit eaten.

LORANTHACEAE.

520 species.—Tropical and temperate regions.

VISCUM Tourn. ex L.

20 species.—Old World.

Viscum album L. Sp. Pl. (1753) 1023.

Vernacular name: Mistletoe, Kazhlavan, Kajhvavan.

Locality: *N.W.*: Above Dossali Fort, bed of Khunai River, 5,050 ft., on *Olea cuspidata*, very common (B. & F. 69 ! 1095 ! 1096 !), bed of Khaisora River, 5,050 ft. (B. & F. 70 !).—Razani, on *Quercus ilex*, common (F. 2015 ! 2168 !), on *Olea cuspidata* (F. 2048 !).

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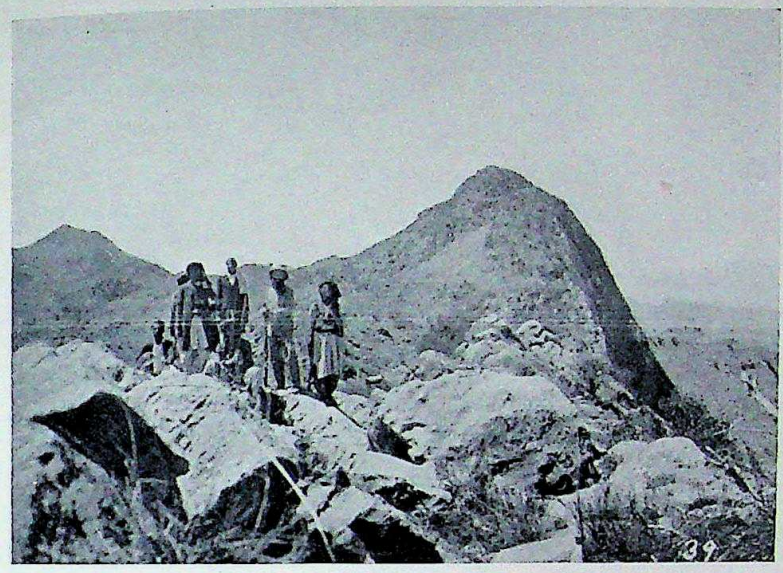

16. Peak of Chota Darweshta, W. of Spinwam Fort.

17. View towards S. from Shewa Post. Narai Pal and Volam Rivers join here. Vegetion *Withania coagulans* Dunal, *Capparis decidua* Edgew., *Acacia modesta* Wall.

Photos by J. Fernandez.

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S.W.: Near Kaniguram village, abundant on Oaks (Stewart).—N. of Doboi, about 5,000 ft., on a feeder of the Zam, common on *Quercus* and *Olea europ.* (Stewart).

Flowers: 12-4-30 (Dossali Fort).

Distribution: Kuram Valley, Drosh, Chitral, W. Himalaya, Kashmir to Nepal, 3,000-9,000 ft., Burma, Afghanistan, Europe, Orient, N. Asia, Japan.

BUXACEAE.

30 species.—Temperate and tropical regions.

Buxus L.

25 species.—Palaeotemperate, West Indies.

Buxus papilosa C. K. Schneid. Ill. Handb. Laubholzk. ii (1907) 139.—*B. sempervivens* L. in Fl. Brit. Ind. (*partim*).

Vernacular name: Box, Shamshath (Mashudi).

Locality: *N.W.*: E. of Miram Shah Fort, on hills, 3,600 ft. (B. & F. 568 !).

S.W.: Above Anai Gorge, about 4,000 ft., common (Stewart).—Sararogha (F. 135 ! 137 ! 213 ! 231 !).

Fruit: 29-3-30 (Miram Shah); 21-5-27 (Sararogha).

Distribution: Outer Himalaya, 2,000-4,000 ft., from the Jhelum westward, Salt Range, Trans-Indus.

EUPHORBIACEAE.

4,000 species.—Cosmopolitan, except arctic.

Euphorbia L.

750 species.—Chiefly subtropical and warm temperate.

Euphorbia thymifolia Burm. Fl. Ind. 2.

Locality: *N.W.*: Dwa Warkha (Stewart).

Distribution: All hot countries, except Australia.

Euphorbia Clarkeana Hook. f. Fl. Brit. Ind. v (1887) 253.

Locality: *Tank* (J. Williams 7209 !).

Flowers: May 1888 (Tank).

Distribution: Punjab, Rajputana, W. Peninsula, Sind.

Euphorbia pilosa L. Sp. Pl. (1753) 460.

Locality: *S.W.*: Pre Ghal (Hay, Duthie's Collect. 15595 !).

Flowers: 17-5-1895 (Pre Ghal).

Distribution: W. Himalaya, Soongaria, E. Siberia, westwards to the Atlantic.

Euphorbia hypericifolia L. Hort. Cliff. 198.

Locality: *N.W.*: Razani (Stewart).

Tank: In water (J. Williams 7921 !).

Flowers: 1-6-1888 (Tank).

Distribution: Throughout tropics of both hemispheres except Australia and the Pacific.

Euphorbia leptocaula Boiss. in DC. Prodr. xv, 159.

Locality: *N.W.*: Hills E. of Miram Shah Fort, among boulders and sandy soil, 3,600 ft. (B. & F. 556 !).—Miram Shah (F. 402 ! 950 ! 960 !).

S.W.: E. of Razmak Camp (B. & F. 1952 !).

Flowers & Fruit: 29-3-30 (Miram Shah); 13-4-27 (Miram Shah); 28-4-30 (Razmak).

Distribution: S.W. Russia, Caucasus.

Euphorbia Gerardiana Jacq. Austr. v, 17.

Locality: *N.W.*: Dossali, in nala called Rosh, 4,900 ft. (B. & F. 1293 !).

Flowers & Fruit: 15-4-30 (Dossali).

Distribution: Europe, Orient.

Euphorbia indica Lam. Encycl. ii (1786) 423; Boiss. Fl. Or. iv, 1088.

Locality: *S.W.*: Jandola, open stony ground and nalas, 2,270 ft. (F. 640 !).

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Flowers & Fruit: 24-5-27 (Jandola).
Distribution: Egypt, Arabia, tropical Africa.

Euphorbia granulata Forsk. Fl. Aeg.-Arab. (1775) 94.
Locality: *N.W.*: Khajuri Post, ridge along left bank of Sua Algad, 2,450 ft. (B. & F. 397 !).
S.W.: Jandola (F. 271 !).
Tank (J. Williams 7208 ! 7922 !).
Flowers & Fruit: 26-3-30 (Khajuri Post); 27-5-27 (Jandola); 5-6-1888 (Tank).
Distribution: Punjab, Malva, Chota Nagpur, Rajputana, W. Peninsula, Sind, Afghanistan, Arabia, Egypt, Canary Islands.

Euphorbia turcomanica Boiss. Cent. Euph. 13.
Locality: *N.W.*: Shewa Post, bed of Kuram River (B. & F. 930 !).
Flowers & Fruit: 5-4-30 (Shewa Post).
Distribution: Mesopotamia, Persia.

Euphorbia humifusa Willd. Enum. H. Berol. Suppl. 13.
Locality: *S.W.*: Sarwekai, 3,930 ft. (F. 3926 !).—Tenai (F. 4040 !).
Flowers & Fruit: 7-6-27 (Sarwekai); 21-6-27 (Tenai).
Distribution: Caucasus, Siberia, Japan, Mongolia, China. Adventitious in other places.

Euphorbia microphylla Heyne in Roth Nov. Pl. Sp. (1821) 229.
Locality: *S.W.*: Wana, on gravel, 4,560 ft. (F. 3576 !).—Jandola, along Tank River, 2,270 ft. (F. 736 ! 4417 !).—Sararogha, 4,000 ft. (F. 236 !).—Sarwekai, 3,930 ft. (F. 4406 !).
Flowers & Fruit: 21-5-27 (Sararogha); 26-5-27 (Jandola); 8-6-27 (Sarwekai); 15-6-27 (Wana).
Distribution: India, Burma, Java.

Euphorbia pauciradiata Blatter in Journ. Bomb. Nat. Hist. Soc. (1933) 483.
Vernacular name: Kharbita (Waziri).
Locality: *N.W.*: Miram Shah, 3,150 ft. (F. 981 ! 981a ! 982 ! 983 !).—Near Spinwam, on boulder strewn slope of Chota Darweshta, 4,800 ft. (B. & F. 749 !).
Flowers & Fruit: 2-4-30 (Spinwam); 13-4-27 (Miram Shah).
Uses: The fruit is a favourite food of the Chukor (*Alectoris graeca*).

Euphorbia helioscopia L. Sp. Pl. 459.
Vernacular name: Sagergotiae (Waziri).
Locality: *N.W.*: Miram Shah, in fields along water channels (F. 841 !).—Datta Khel (F. 1247 !).
S.W.: Kaniguram (Stewart).—Barwand, 4,000 ft. (Duthie's Collect. 15713 !).
Tank (J. Williams 7207 !).
Flowers: 25-3-27 (Datta Khel); 16-4-27 (Miram Shah); 26-4-1895 (Barwand); 4-5-1888 (Tank).
Distribution: W. Himalaya, Punjab, Afghanistan, westwards to the Atlantic.
Uses: Juice used in herpes (Williams).

Euphorbia helioscopioides Blatter in Journ. Bomb. Nat. Hist. Soc. (1933) 483.
Vernacular name: Chalwar-gotiae, Parparai (Waziri).
Locality: *N.W.*: Fields near Datta Khel village, 4,600 ft. (B. & F. 1497 !).—Boya Fort, bed of Tochi River, 3,550 ft. (B. & F. 92 !).—Miram Shah Fort, Chasmai River, in cultivation (B. & F. 343 !).—Datta Khel (F. 1245 ! 1388 !).—Boya, cultivated fields (F. 1174 !).
S.W.: Sararogha (F. 92 ! 105 ! 105a !).
Flowers & Fruit: 21-3-30 (Boya); 24-3-30 (Chasmai River); 25-3-27 (Datta Khel), 5-4-27 (Boya); 17-4-30 (Datta Khel); 18-5-27 (Sararogha).

Euphorbia Esula L. Sp. Pl. (1753) 660.
Locality: *N.W.*: Boya (F. 278 !).
Flowers & Fruit: 2-4-27 (Boya).
Distribution: Europe, Central and S. Europe, Orient, Siberia, China.

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Euphorbia sp. *affinis E. Buhsei* Boiss. in DC. Prodr. xv, 167.
Involucri lobi flavi.
Locality: *N.W.*: Near Miram Shah, rocky left bank of Chasmai River (B. & F. 321 !).
Flowers & Fruit: 24-3-30.

Euphorbia sp. (*Sect. Esulae*).
Frutex 80 *cm. altus, virgatus. Caules angulato-striati. Involucri lobi truncati-fimbriati. Glandulae magnae bicornutae.*
Vernacular name: Khajhabali (Waziri).
Locality: *N.W.*: Miram Shah (F. 1390 !).
Flowers & Fruit: 14-4-27.

Euphorbia sp. near *E. Szovitsii* F. & M. Index Petrop. i, 27.
Locality: *S.W.*: Jandola (F. 4126 !).
Flowers & Fruit: 29-5-27 (Jandola).

Andrachne L.

15 species.—Tropics and subtropics.

Andrachne telephioides L. Sp. Pl. 1014.
Vernacular name: Menboti (Williams); Saebitae (Waziri).
Locality: *N.W.*: Razani (Stewart).—Hills E. of Miram Shah Fort, 3,600 ft. (B. & F. 542 !).—Khajuri Post, right bank of Sua Algad, gravel, 2,250 ft. (B. & F. 360 !).—Gravel plain W. of Spinwam, 2,650 ft. (B. & F. 835 !).—E. of Spinwam Fort, nearest sandstone ridge, 2,800 ft. (B. & F. 786 !).—Near Miram Shah Fort, bed of Chasmai River, gravel and sand, 3,100 ft. (B. & F. 253 ! 312 !).—W. of Miram Shah Fort, gravel plain, 3,150 ft. (B. & F. 616 !).—Miram Shah village, clayey bank of irrigation channel, 3,050 ft. (B. & F. 472 !).—Datta Khel Fort, in garden, 4,600 ft. (B. & F. 1409 !).—Datta Khel village, 4,600 ft. (B. & F. 1444 !).—E. of Datta Khel Fort, stony plain (B. & F. 1358 !).—Dossali Fort, nala, 4,900 ft. (B. & F. 1050 ! 1060 !).
S.W.: Barwand (Duthie's Collect. 15640 !).—Wana, open stony plain, 4,560 ft. (F. 3466 ! 3567 !).—Spin (F. 3535 !).—Sarwekai, 3,930 ft. (F. 3913 !).—Tenai, 3,200 ft. (F. 4024 !).
Tank: Near Tank, Shaur Hill (J. Williams !).
Flowers & Fruit: 26-3-30 (Khajuri); 29-3-30 (Miram Shah); 4-4-30 (Spinwam; 17-4-30 (Datta Khel); 28-4-1895 (Barwand); 31-5-1891 (Tank); 16-6-27 (Wana).
Distribution: Punjab, Salt Range, Afghanistan, westwards to the Atlantic.

Phyllanthus L.

500 species.—Temperate and tropical regions, excluding Europe and N. Asia.

Phyllanthus debilis Herb. Ham. ex Wall. Cat. (1828) *sub* no. 7892.
Locality: *N.W.*: N. of Dossali Fort, slopes of Picket Hill (B. & F. 1279 !).—Dossali Fort, 4,900 ft. (B. & F. 1038a !), left bank of Khaisora River, 4,800 ft. (B. & F. 1165 !).
Flowers & Fruit: 10-4-30 (Dossali); 15-4-30 (Dossali).
Distribution: India (N.-W. Provinces, Bihar, Assam, W. Peninsula), tropical Africa.

Phyllanthus urinaria L. Sp. Pl. (1753) 982.
Locality: *N.W.*: Razani, 5,000 ft. (F. 2360 !).
Flowers & Fruit: 27-4-27 (Razani).
Distribution: Tropics generally.

Chrozophora Neck.

10 species.—Mediterranean, India, W. Africa.

Chrozophora obliqua A. Juss. ex Spreng. Syst. Veg. iii (1826) 850 **var. genuina** Prain in Kew Bull. (1918) 112.
Locality: *S.W.*: Sarwekai, 3,930 ft. (F. 3962 !).
Flowers: 7-6-27 (Sarwekai).

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Distribution: Mediterranean, Asia Minor, Syria, Mesopotamia, Persia, Turkestan.

Chrozophora hierosolymitana Spreng. Syst. Veg. iii (1826) 850; Prain in Kew Bull. (1918) 109.
Locality: *Tank* (Duthie 7205 ex Prain).
Distribution: N.W. India, N.W. Himalaya, Baluchistan, Afghanistan, Orient, Asia Minor, Arabia, Egypt.

RICINUS (Tourn.) L.

1 species.—Tropical Africa.

Ricinus communis L. Sp. Pl. (1753) 1007.
Vernacular name: Randanh (Waziri).
Locality: *N.W.*: Shewa Post, right bank of Kuram River (B. & F. 926 !).
Distribution: Tropics generally.

ULMACEAE.

130 species.—Tropical and temperate regions.

CELTIS Tourn.

75 species.—N. hemisphere, S. Africa.

Celtis australis L. Sp. Pl. (1753) 1043.—*C. caucasica* Willd. Sp. Pl. iv, 994.
Vernacular name: Nettle tree; Taghar (Pu.); Togonh (Waziri).
Locality: *N.W.*: Razani, planted, 5,000 ft. (F. 2125 ! 2128 ! 2131 !).
S.W.: Bungi Wala, about 4,500 ft. (Stewart).—Sararogha, in garden, 4,000 ft. (F. 60 ! 101 ! 2645 !).—Kaniguram, about 8,200 ft. (Stewart).
Flowers: April.
Fruit: April, May.
Distribution: Baluchistan, Kuram Valley, Afghanistan, Salt Range, N.W. Himalaya up to 8,500 ft., often planted.

Celtis tetrandra Roxb. Hort. Beng. (1814) 21.
Locality: *N.W.*: Razani (Stewart).
Distribution: Oudh, Nepal, Sikkim up to 5,000 ft., Bihar, Central Provinces, Orissa, N. Circars, Deccan, W. Ghats, Assam, Chittagong, Burma.

MORACEAE.

800 species.—Tropical and subtropical, a few temperate.

CANNABIS (Tourn.) L.

1 species.—Central Asia.

Cannabis sativa L. Sp. Pl. (1753) 1027.
Locality: *Tank*: Common weed in gardens N. of Tank, cultivated (Stewart).
Distribution: Wild in Central Asia.

*MORUS (Tourn.) L.

12 species.—N. temperate.

***Morus nigra** L. Sp. Pl. 1398.
Locality: *S.W.*: Spin, planted by Kaka Khel tribe (F. 3847 !).—Tenai, 3,200 ft. (F. 3798 !).—Wana, 4,500 ft. (F. 3599 !).
Distribution: Europe, planted elsewhere.

***Morus alba** L. Sp. Pl. (1753) 986; Parker For. Fl. Punj. (1918) 473.
Vernacular name: Mulberry; Teeth (Waziri); Tut.
Locality: *N.W.*: Boya, planted, 4,000 ft. (F. 1357 ! 1358 !).—Razani, cultivated, 5,000 ft. (F. 2177 ! 2184 ! 2189 !).—Miram Shah (B. & F. 521 !).
S.W.: Sararogha, cultivated, 4,000 ft. (F. 128 !).
Tank (J. Williams 9184 !).
Flowers: April.

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Fruit: 28-3-30 (Miram Shah).
Distribution: Probably a native of China.—Cultivated in Afghanistan, Kuram Valley, Baluchistan, Punjab, Kashmir, N.W. Himalaya.

* **Morus laevigata** Wall. Cat. no. 4649.
Vernacular name: Teeth (Waziri).
Locality: *N.W.*: Boya, cultivated, 4,000 ft. (F. 1359 !).—Miram Shah, cultivated, 3,000 ft. (F. 1068 !).
Flowers: April.
Fruit: April at Miram Shah.
Distribution: Outer Himalaya from Kumaon eastwards, Assam, Khasia Hills, Upper Burma, Martaban, Tenasserim.

* **Morus indica** L. Sp. Pl. (1753) 986.
Vernacular name: Tuth (at Boya).
Locality: *N.W.*: Boya, cultivated, 4,000 ft. (F. 895 !).
S.W.: Sararogha, cultivated, 4,000 ft. (F. 23 !).
Young fruit: 30-3-27 (Boya).
Distribution: Sub-Himalayan tract in dry forests from the Sutlej eastwards, up to 5,000 ft. (Brandis).

* **Morus serrata** Roxb. Hort. Beng. (1814) 103.
Vernacular name: Teeth (Waziri).
Locality: *N.W.*: Razani, cultivated, 5,000 ft. (F. 2139 ! 2142 !).
Distribution: Baluchistan, Trans-Indus to Kumaon, chiefly in the inner ranges.

FICUS Tourn. ex L.

800 species.—Tropics, chiefly E. Indies, Polynesia, etc.

Ficus palmata Forsk. Fl. Aeg.-Arab. (1775) 179.
Vernacular name: Inzar (Waziri); Toga.
Locality: *N.W.*: Miram Shah, wild, 3,000 ft. (F. 961 ! 962 ! 963 ! 964 !).—Razani, wild, 5,000 ft. (F. 2828 ! 2851 !).—Boya, 4,000 ft. (F. 897 ! 1350 ! cultivated).—Datta Khel, in garden, 4,600 ft. (B. & F. 1420 !).—Datta Khel village (B. & F. 1514 !).
S.W.: Razmak, below Springs, 7,700 ft. (B. & F. 1834 !).
Tank: (J. Williams 9228 !).
Distribution: Baluchistan, Eastern slopes of the Suleiman Range, Salt Range and plains of Punjab, Mt. Abu, Merwara, N.W. Himalaya up to 5,000 ft., on the Sutlej to 9,000 ft. eastwards as far as Nepal (Brandis).

* **Ficus religiosa** L. Sp. Pl. (1753) 1059.
Vernacular name: Pipal.
Locality: *Tank*: City of Tank, planted (Stewart).
Distribution: Wild in the Sub-Himalayan forests, Bengal, Central India, elsewhere cultivated.

* **Ficus carica** L. Sp. Pl. (1753) 1513.
Locality: *N.W.*: Miram Shah (F. 1069 !).
Tank (J. Williams 7211 !).
Distribution: Supposed to be indigenous in Syria and Palestine.

* **Ficus glomerata** Roxb. Corom. Pl. ii (1798) 13, t. 123.
Locality: *N.W.*: Miram Shah, planted (B. & F. 522 !).
Distribution: Throughout India, Ceylon.

URTICACEAE.

480 species.—Tropics and temperate.

URTICA (Tourn.) L.

30 species.—Temperate regions.

Urtica dioica L. Sp. Pl. (1753) 984.
Vernacular name: Sayankai (Afghanistan); Sisinaka, Sezinkae (Waziri) (=the stinger).

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Locality: *N.W.*: Dariawasti Algad, near Datta Khel (B. & F. 1650 ! 1656 !).—Chasmai River, right bank, in silt between grass, 3,100 ft. (B. & F. 218 !).—Boya Fort, on sandy bank of Tochi River, 3,550 ft. (B. & F. 110 !).—E. of Datta Khel Fort, stony plain, 4,600 ft. (B. & F. 1344 !).—Below Dossali Fort, left bank of Khaisora River (B. & F. 1148 ! 1149 ! 1150 !).

S.W.: Pre Ghal (Hay).

Flowers: 23-3-30 (Chasmai River); 19-4-30 (Near Datta Khel).

Fruit: 13-4-30 (Dossali).

Distribution: N. W. Himalaya, 8,000-12,000 ft., Salt Range, westwards to the Atlantic.

Urtica pilulifera L. Sp. Pl. 1395.

Vernacular name: Sezankie, Sezinka (Waziri).

Locality: *N.W.*: Miram Shah (F. 386 !).

S.W.: Razmak (F. 2251 ! 2280 !).

Flowers: 14-4-27 (Miram Shah).

Distribution: Europe, N. Africa, Orient.

POUZOLZIA Gaudich.

40 species.—Palaeotropics.

Pouzolzia sp.

Vernacular name: Sezinka, Sezankie (Waziri).

Locality: *N.W.*: Miram Shah, 3,000 ft. (F. 386 !).

S.W.: Razmak, 6,500 ft. (F. 2251 ! 2266 ! 2280 !).

Flowers: April.

PARIETARIA (Tourn.) L.

7 species.—Temperate and tropics.

Parietaria debilis Forst. f. Prodr. 73; Boiss. Fl. Or. iv (1879) 1150.

Locality: *N.W.*: Miram Shah, 3,000 ft. (F. 508 ! 518 !).

Flowers & Fruit: April.

Distribution: Abyssinia, Afghanistan, Kuram Valley, Baluchistan, Punjab to Sikkim, China, many temperate and tropical regions, extending to Australia and Chili.

FORSKOHLEA L.

5 species.—Mediterranean to India.

Forskohlea tenacissima L. Mant. 72.

Locality: *S.W.*: Palosina, common on cliffs (Stewart).—Jandola, 2,270 ft. (F. 4116 !).

Tank: Near Tank (J. Williams 7892 !).

Flowers: 16-6-1888 (Tank).

Distribution: Punjab, Sind, Baluchistan, westwards to Arabia and N. Africa, Spain.

PLATANACEAE.

1 genus.

*PLATANUS (Tourn.) L.

5 species.—N. temperate.

*** Platanus orientalis** L. Sp. Pl. 999.

Locality: *N.W.*: Miram Shah, 3,150 ft. (B. & F. 4 !).

S.W.: Razmak, planted in avenue, 6,500 ft. (F. 1557 ! 1558 !).

Distribution: Indigenous in the eastern Mediterranean region.—Cultivated in Afghanistan, Kuram Valley, Baluchistan, N.W. Himalaya, Punjab.

JUGLANDACEAE.

40 species.—N. temperate, tropical Asia.

JUGLANS L.

12 species.—N. hemisphere, Andes.

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Juglans regia L. Sp. Pl. (1753) 997.
Vernacular name: Matak (Waziri).
Locality: *N.W.*: Razani, cultivated, 5,000 ft. (F. 2081 ! 2012 ! 3013 ! 3014 !).
S.W.: Ridge of Pre Ghal (Stewart).
Flowers: April, May.
Distribution: Indigenous in the Kuram Valley, N.W. Himalaya, Sikkim, Upper Burma.

BETULACEAE.

105 species.—N. temperate, tropical mountains, Andes, Argentine.

*Alnus (Tourn.) L.

17 species.—N. temperate regions, Andes.

***Alnus nitida** Endl. Gen. Pl. Suppl. iv, ii (1847) 20.
Vernacular name: Alder.
Locality: *S.W.*: Razmak, planted, 6,500 ft. (F. 1801 ! 1802 ! 1803 !).
Distribution: N.W. Himalaya, extending eastwards to the Jumna up to 9,000 ft., Kunawar, Hazara.

FAGACEAE.

350 species.—Tropical Asia, California, S. America, New Zealand, S. Australia.

Quercus (Tourn.) L.

300 species.—N. temperate, Indo-Malaya, Pacific coasts, etc.

Quercus ilex L. Sp. Pl. (1753) 995.
Vernacular name: Holm Oak, Chedai, Sperkai Chedai.
Locality: *N.W.*: Boya, common (F. 1506 ! 1508 !).—Above Dossali Fort, bank of Khunai River, 5,150 ft. and upwards (B. & F. 1143 ! 1145 !).—Dossali, in nala (B. & F. 1040 ! 1144 ! 1146 !).—Razani (F. 2078 ! 2135 ! 2817 ! 2818 !).
S.W.: Razmak (F. 3318 !).—S.W. of Razmak, hill, 6,950 ft. (B. & F. 1931 !, F. 1844 !).—E. of Razmak (F. 2784 ! 3294 ! 3314 ! 3351 ! 3347 !).—Pre Ghal (Hay, J. Williams 7927 !).—Near Kaniguram, 6,500-8,200 ft. (Stewart).—Wana (F. 3681 ! 3692 ! 3700 ! 3701 !).
Leaves coming out: 30-4-27 (Razmak).
Flowers: 12-4-30 (Dossali); 27-4-30 (Razmak); 5-5-27 (Razmak).
Uses: Fruit eaten. Wood used as fuel.
Distribution: Kuram Valley, 6,500-9,000 ft., N.W. Himalaya, Afghanistan, Mediterranean region.

Quercus dilatata Lindl. in Wall. Cat. (1828) no. 2785.
Vernacular name: Holly Oak, Gora chirai, Gada charai (Waziri).
Locality: *N.W.*: Razani, common (F. 2969 ! 2999 ! 3001 !).
S.W.: Pre Ghal (Hay, J. Williams 7926 !).—Razmak, below Springs, 7,700 ft. (B. & F. 1858 ! 1859 !, Palacios 1876a !, F. 1748 ! 1836 ! 2234 ! 2302 ! 2646 ! 3189 ! 3320 !).
Young leaves coming out: 25-4-27 (Razani); 5-5-27 (Razmak).
Flowers: 25-4-30 (Razmak).
Distribution: N.W. Himalaya, 5,000-9,000 ft., Kunawar, Kuram Valley, 7,000-8,500 ft., Afghanistan.

Quercus semecarpifolia Smith in Rees Cyclop. xxix (1819) no. 20.
Vernacular name: Ghadha, tcherai, Charlanza tcherai.
Locality: *S.W.*: Pre Ghal (Hay).—Shuidar, 9,000-10,000 ft. (F. 1532 ! 1533 !), associated with pines (F. 1649 ! 1670 ! 1671 ! 2546 !).—This is the oak of the higher regions.
Distribution: Kuram Valley, 9,000-11,000 ft., Himalaya 8,000-10,000 ft., E. Manipur 8,000-10,000 ft., China.

Quercus incana Roxb. Hort. Beng. (1814) 113.
Vernacular name: White Oak.

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Locality: *N.W.*: Loargai Narai, 6,500 ft. (B. & F. 1535a !).
S.W.: Shuidar, 9,000-10,000 ft. (F. 1535 !).
Distribution: Outer N.W. Himalaya to Nepal, 4,000-8,000 ft., Salt Range, Trans-Indus.

Quercus glauca Thunb. Fl. Jap. (1784) 175.
Locality: *N.W.*: In the upper regions (Stewart), very likely planted.
Distribution: Valleys of the outer Himalaya up to 6,000 ft., Khasia Hills, China.

SALICACEAE.

180 species.—N. temperate, tropics and subtropics.

Salix (Tourn.) L.

160 species.—Cosmopolitan.

Salix acmophylla Boiss. Diagn. ser. 1, vii (1846) 98.
Vernacular name: Vallah, Wollah (Waziri).
Locality: *N.W.*: Boya, along fields on bank of Tochi River, 4,000 ft. (F. 1338 ! 1339 ! 1340 ! 1342 !).—Isha (B. & F. 400 !).—Datta Khel, along Tochi River, 4,500 ft. (F. 1274 ! 1308 ! 1317 !).—Razani in patch of cultivation along stream, 5,000 ft. (F. 2141 !).—Spinwam Fort (B. & F. 430 !).
S.W.: Shuidar, 9,000 ft. (F. 1552 !).
Flowers: March, 27-3-30 (Spinwam); 30-3-30 (Boya); April.
Distribution: Afghanistan, Kuram Valley, Baluchistan, N. Punjab, Kashmir, sub-Himalayan tract east of the Ganges, W. Asia.
Uses: Eaten by camels. Wood burnt and coal used in making crackers.

Salix Wallichiana Anders. in Act. Holm. (1850) 447.
Vernacular name: Vallah (Waziri).
Locality: *S.W.*: Sararogha, along Tank River, 4,000 ft. (F. 17 ! 18 !).
Distribution: Afghanistan, Kuram Valley, 10,000-12,000 ft., Himalaya 2,000-9,000 ft., China.

* **Salix babylonica** L. Sp. Pl. 1017; Boiss. Fl. Or. v (1884) 1185.
Vernacular name: Weeping Willow, Vallah.
Locality: *N.W.*: Miram Shah, in fields along Tochi River, 3,000 ft. (F. 795 ! 965 !).—Dwa Warkha (Stewart).
S.W.: Razmak, in garden (B. & F.).—Wana, S.E. of Camp, 4,500 ft. (F. 3577 ! 3586 ! 3610 !).—Wana, in garden along stream (F. 3595 !).—Jandola, along Tank River, 2,200 ft. (F. 786 !).—Above Palosina, along banks of stream (Stewart).
Flowers: June.
Distribution: Indigenous in N. China, also very likely in N. Persia and Kurdistan.

* **Salix alba** L. Sp. Pl. 1021.
Locality: *N.W.*: Datta Khel village, 4,600 ft. (B. & F. 1488 !).—Datta Khel Fort, 4,600 ft. (B. & F. 1365 ! 1366 !).
Fruit: 16-4-30 (Datta Khel Fort); 17-4-30 (Datta Khel village).
Distribution: Europe, Orient, N. Asia. Cultivated in N.W. Himalaya.

Populus L.

20 species.—N. temperate.

Populus suaveolens Fisch., Led. Fl. Ross. iii, 629; Fedtschenko & Fedtschenko Consp. Fl. Turk. pt. 6 (1916) 332.—*P. balsamifera* Hook. f. in Fl. Brit. Ind. v (1888) 638; Brandis Ind. Trees (1911) 640, *et aliorum auctorum, non Linn.*—*P. balsamifera var. laurifolia* Wesm. *et var. suaveolens* Loud., Rgl. in Act. Hort. Petrop. vi, 474 *et* 475.—*P. laurifolia* Led. Fl. Alt. iv, 297 (*excl. syn. plur.*); Led. Fl. Ross. iii, 629.
Vernacular name: Balsam Poplar, Chenar.
Locality: *N.W.*: Datta Khel Fort, 4,600 ft. (B. & F. 1416 !).
S.W.: Wana, planted, said to be introduced from Kabul, 4,500 ft. (F. 3647 !).

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Distribution: Indigenous in Central and N. Asia and, according to some, in N. America.

Populus euphratica Oliv. Voy. iii (1801) 449, tab. 45, 46.
Locality: *S.W.*: Above Palosina, along banks of stream (Stewart).
Distribution: Sind, Baluchistan, Afghanistan, Punjab, W. Tibet, westwards to Syria and Egypt.

Populus nigra L. Sp. Pl. (1753) 1034, **var. pyramidalis** Spach; Aitchis. Bot. Afgh. Del. Com. (1888) 111; Burkill Fl. Pl. Baluch. (1909) 72; Brandis Ind. Trees (1911) 640; Parker For. Fl. Punj. (1918) 511.
Vernacular name: Pyramidal Poplar, Lombardy Poplar.
Locality: *S.W.*: Between Dargai Post and Sarwekai (F. 3707 ! 3708 !).
Distribution: 'It is a staminate sport from *P. nigra var. typica*, originating in the plains of Lombardy about 1,700-1,720 ft. and now widely spread over the world by means of cuttings' (L. H. Bailey).
'Frequently planted in the N.W. Himalaya, particularly in Kashmir, in Ladak as high as 12,500 ft. Also occasionally in the plains of the Punjab, and of late years in Baluchistan' (Brandis).

***Populus alba** L. Sp. Pl. (1753) 1034.
Vernacular name: White Poplar; Spedore (Waziri); Sufedor (at Tank).
Locality: *N.W.*: Dwa Warkha (Stewart).—Razani, cultivated, 5,000 ft. (F. 2147 ! 2149 !).—Datta Khel village, 4,600 ft. (B. & F. 1438 !).
S.W.: Dargai Post, planted (F. 4068 ! 4181 !).—Wana, planted, 4,500 ft. (F. 3486 ! 3487 ! 3605 !).—Above Palosina along banks of stream (Stewart). —Sararogha (F. 119 !).
Tank (J. Williams 9229).
Distribution: N.W. Himalaya, 4,000-10,000 ft., wild and cultivated. Planted in Baluchistan, Kuram Valley, Punjab, Europe, N. Africa, N. and W. Asia, China (Brandis).
Uses: Planted for timber.

***Populus tremula** L. Sp. Pl. 1464.
Vernacular name: Spolilai (Waziri).
Locality: *N.W.*: Miram Shah, 3,150 ft. (B. & F. 40 !).—Datta Khel village, 4,600 ft. (B. & F. 1436 !).
Distribution: Europe, Orient, Siberia, Dahuria, Japan, N. Africa.

GNETACEAE.

800 species.—Cosmopolitan.

Ephedra Tourn. ex L.

25 species.—Warm temperate.

Ephedra foliata Boiss. Fl. Or. v (1881) 716.—*E. peduncularis* Boiss. l.c. 717.
Vernacular name: Khadang-gawa, Gadanga-gawa, Creda, Ghardavangha.
Locality: *N.W.*: Boya Fort, right bank of Tochi River, 3,550 ft. (B. & F. 84 !, F. 1112 ! 1465 !), on sandy clay (B. & F. 1684 !).—Miram Shah, hills E. of, 3,600 ft. (B. & F. 557 ! 558 ! 993 !).—Near Miram Shah, rocky bank of Chasmai River (B. & F. 296a !).—Dossali Fort, left bank of Khaisora River (B. & F. 1166 !).—N. of Dossali Fort, rocky nala, climbing on *Quercus ilex* (B. & F. 1290 ! 1291 !).—Dossali, right bank of Khunai River, 5,500 ft. (B. & F. 1139 !).—Spinwam Fort, slope of Chota Darweshta, 3,000-4,800 ft. (B. & F. 751 !).—Spinwam, nearest hill E. of, 2,900 ft. (B. & F. 802 ! 809 !). —Shewa Post (B. & F. 917 ! 918 !).
S.W.: Razmak, below Springs, 7,700 ft. (B. & F. 1869 !).—Hill E. of Razmak Camp, 6,800 ft. (B. & F. 1877 !).—Jandola (F. 2024 ! 4099 !).—Sarwekai (F. 4045 !).
Flowers: 29-3-30 (Miram Shah); 2-4-30 (Spinwam); 5-4-27 (Boya); 13-4-27 (Miram Shah); 24-4-30 (Boya).
Fruit: 29-5-27 (Jandola).
Distribution: Punjab, Rajputana, Sind, Baluchistan, Afghanistan to Syria.

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Ephedra Gerardiana Wall. Cat. (1828) no. 6048.—*E. vulgaris* Hook. f. in Fl. Brit. Ind. v, 640.

Locality: *S.W.*: N. of Razmak Camp, below Springs, 7,700 ft. (B. & F. 1806 !).—Slope of Shuidar, 9,000-11,000 ft. (F. 1542 !).—Shuidar, forming clumps at about 8,000 ft. (F. 1625 !).

Distribution: Temperate and alpine Himalaya 7,000-12,000 ft., Sikkim 12,000-16,000 ft., W. and Central Asia, Europe.

Ephedra nebrodensis Tineo in Guss. Fl. Sic. Syn. ii, 638, **var. procera** Stapf.

Locality: *S.W.*: Razmak (Herb. Dehra Dun 47326 !).

Distribution: Mediterranean, N. Asia.

PINACEAE.

About 300 species.—Mostly temperate.

Abies (Tourn.) L.

Abies Pindrow Spach Hist. Phanerog. xi, 423; Royle Ill. t. 86; Parker For. Fl. Punj. (1918) 542; Troup Silvic. Ind. Trees (1921) 1133.—*A. Webbiana* Lindley *var. Pindrow* Brandis For. Fl. (1874) 528; Hook. f. in Fl. Brit. Ind. v, 655.—*Pinus Pindrow* Royle Ill. 354, t. 86.

Vernacular name: W. Himalaya low-level silver fir; Almanza (Waziri).

Locality: *S.W.*: N. of Razmak Camp (F. 1609 ! 2538 !).—Slope of Shuidar, 9,000-11,000 ft. (B. & F. 1628 !).

Distribution: Kuram Valley, W. Himalaya from Afghanistan to Nepal 7,500-11,000 ft. and even up to 12,000 ft., Chitral.

Picea Link.

35 species.—N. hemisphere.

Picea Morinda Link in Linnaea xv, 522; Hook. f. in Fl. Brit. Ind. v, 653; Brandis Ind. Trees (1911) 692; Troup Silvic. Ind. Trees (1921) 1143.—*Abies Smithiana* Forbes Pinet. Woburn. 103, t. 30; Aitchis. Fl. Kuram Valley (1880) 98; Brandis For. Fl. (1874) 525.—*Picea Smithiana* Boiss. Fl. Or. v (1884) 700. —*Pinus Khutrow* Royle Ill. 353, t. 84.—*Abies spinulosa* Griff. Ic. Pl. As. t. 363.

Vernacular name: The Himalayan Spruce; Sarap (Waziri).

Locality: *S.W.*: N. of Razmak Camp (F. 1663 ! 1725 ! 1776 ! 1779 ! 1786 ! 1787 ! 1788 ! 2314 ! 2418 ! 2450 ! 2478 ! 2509 ! 3035 ! 4183 ! 4201 ! 4453 !).—Slope of Shuidar, 9,000-11,000 ft. (B. & F. 1627 !).

Distribution: Kafiristan, Chitral, Kuram Valley, Himalaya from Kashmir to Garhwal, 7,000-11,000 ft., Sikkim and Bhutan, 8,000-15,000 ft.

Pinus (Tourn.) L.

70 species.—N. temperate and on mountains in the N. tropical regions.

Pinus excelsa Wall. Pl. As. Rar. t. 201; Griff. Ic. Pl. As. t. 366; Boiss. Fl. Or. iv (1879) 698; Troup Silvic. Ind. Trees (1921) 1815.

Vernacular name: Blue Pine, Nastar (Waziri); Nuhktar in Kuram Valley (ex Aitchis.).

Locality: *S.W.*: Pre Ghal (J. Williams 7928 !).—Razmak Camp, plentiful, forming small forests on the hill range N. of Razmak. Associated with *Quercus ilex* L. (F. 1723 ! 1724 ! 1732 ! 1772 ! 2384 ! planted, 2536 ! 2537 ! 4451 ! 4452 !).—On top of Shuidar Peak, 10,980 ft. and on the slopes of the range N. of Razmak Camp (F. 2532 ! 4224 !).—Cone picked up in the Tank River at Jandola, very likely carried down from the higher hills (F. 4185 !).—Slopes of Shuidar, 9,000 ft. (B. & F. !).

Distribution: Throughout the temperate regions of the Himalaya, chiefly 6,000-12,500 ft., to Bhutan (not in Central & N.W. Kumaon and Sikkim), Afghanistan, Kafiristan, Kuram Valley, Baluchistan (Zob and Loralai).

Medical uses: Resin used by local practitioners against impotence. Prepared in milk or honey and then mixed with an equal quantity of sugar, it is taken for 40 days.

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Pinus Gerardiana Wall. in Lamb. Pin. Ed. 3, t. 79; Brandis For. Fl. (1874) 508, t. 67, Ind. Trees 690; Royle Ill. t. 85; Clegh. Pines N.W. Himalaya t. 4; Parker For. Fl. Punj. (1918) 539.

Vernacular name: Himalayan edible pine, Chilgoza pine; Zangezie, Zanguzie (Waziri).

Locality: *N.W.*: Cones picked up in the Tochi River at Boya (F. 4203 !).

S.W.: On top of Shuidar Peak, only a few trees, 10,980 ft. (F. 1773 ! 1774 ! 1775 ! 1777 ! 1778 ! 2341 ! 2494 ! 2510 ! 2511 ! 2512 ! 4449 !).—Plentiful on slopes N. of Razmak Camp (F. 2495 !).—Slopes of Shuidar, 9,000-11,000 ft. (B. & F. 1626 !).

Distribution: Afghanistan (Khost, Kafiristan), Baluchistan (Zhob, Takht-i-Suliman), Kuram Valley (Hariab 7,000-11000 ft.), from Chitral to the Niti Pass in Garhwal chiefly between 6,000-10,000 ft.

Uses: Nuts eaten as is done everywhere where the pine occurs, seeds sold in Bannu.

***Pinus longifolia** Roxb. Fl. Ind. iii (1832) 651; Royle Ill. t. 85.

Vernacular name: Chir Pine.

Locality: *N.W.*: Miram Shah, garden, 3,150 ft. (B. & F. 35 !).

S.W.: Above Anai Gorge in bed of stream, cultivated (Stewart).

Distribution: Afghanistan, along the Himalaya and Siwalik Hills to Bhutan, 1,500-8,000 ft. (Parker).

Cupressus Tourn. ex L.

12 species.—Mediterranean, Asia, N. America.

***Cupressus sp.**—Too incomplete for determination.

Locality: *S.W.*: Jandola (F. 1524 ! 1526 !).

Thuja L.

6 species.—China, Japan, N. America.

***Thuja orientalis** L. Sp. Pl. 1002.—Oriental Arbor-vitae.

Locality: *N.W.*: Miram Shah (F. 2361 ! 2364 !). Planted.

Fruit: March, young fruits and fruits of the previous year.

Distribution: China, Japan.

Cedrus (Tourn.) Mill.

3 species.—Algeria to Himalaya.

Cedrus Deodara. Loud. Arb. Brit. iv, 2428, f. 2283-2286; Boiss. Fl. Or. iv (1879) 699.—*C. Libani var. Deodara* Hook. f. Himalay. Journ. i, 257.—*Pinus Deodara* Roxb. Fl. Ind. iii, 651.

Vernacular name: Himalayan Cedar, Deodar; Almanzha (Waziri).

Locality: *S.W.*: Shawal, N. of Razmak Camp (F. 4166 ! 4167 ! 4168 ! 4169 ! 4170 ! 4171 ! 4212 ! 4241 !).

Distribution: Afghanistan, Chitral, Kuram Valley, 7,500-10,000 ft., N.W. Himalaya, 4,000-10,000 ft. as far east as Alaknanda, sometimes up to 12,000 ft.

MONOCOTYLEDONEAE.

ORCHIDACEAE.

7,500 species.—Cosmopolitan, abundant in tropical, rare in arctic regions.

Eulophia R. Br.

200 species.—Warm regions of the Old World.

Eulophia campestris Wall. Cat. 7617.

Locality: *S.W.*: Wana, 4,500 ft. (Duthie's Collect. 15776 !).

Flowers & Fruit: 11-5-1895 (Wana).

Distribution: Plains of India, Sikkim, Afghanistan.

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CEPHALANTHERA Rich.

10 species.—N. temperate regions.

Caphalanthera ensifolia Rich. Orchid. Annot. 29.
Locality: *S.W.*: Kanigurum village (Stewart).—Razmak (F. 3133 ! 3138 ! 3159 ! 3256 !).
Flowers: 5-5-27 (Razmak).
Distribution: Temperate Himalaya, 6,000-12,000 ft., from Kashmir to Bhutan, Afghanistan to N. Africa, Europe, W. Siberia.

EPIPACTIS Adans.

10 species.—N. temperate regions.

Epipactis Royleana Lindl. in Roy. Ill. 368.—*E. gigantea* Dougl. in Hook. Fl. Bor. Amer. ii, 202, t. 202.
Locality: Waziristan (Duthie in Orchids of N. W. Himalaya, p. 162).
Distribution: Temperate Himalaya, from Kashmir to Sikkim 7,000-12,000 ft., N. America.

IRIDACEAE.

800 species.—Tropical and temperate regions; the chief centres of distribution S. Africa and tropical America.

IRIS Tourn. ex L.

200 species.—N. temperate.

Iris Sisyrinchium L. Sp. Pl. (1753) 59.
Vernacular name: Khikhai, Dilai, Diliae (Waziri).
Locality: *N.W.*: Datta Khel, 4,600 ft. (Dundas 72 !, F. 1248 !).—Boya, on clay, 3,550 ft. (B. & F. 1686 !, F. 1091 !), along water channels (F. 1039 !), in cultivation (F. 1136 ! 1162 ! 1164 !).—Miram Shah (F. 357 !, B. & F. 30 ! 474 !).—Right bank of Chasmai River, in field, 3,120 ft. (B. & F. 296 !).
Flowers: 19-3-30 (Miram Shah); 20-3-30 (Datta Khel); 25-3-27 (Datta Khel); 28-3-27 (Boya); 28-3-30 (Miram Shah); 5-4-27 (Boya); 16-4-27 (Miram Shah); 21-4-30 (Boya).
Fruit: 28-3-27 (Boya); 16-4-27 (Miram Shah); 21-4-30 (Boya).
Distribution: Baluchistan, Afghanistan, Orient, Mediterranean, N. Africa.

Iris Stocksii Boiss. Fl. Or. v, 123.
Locality: *N.W.*: Datta Khel, stony ground (F. 1183 ! 1188 !).—Bed of Khunai River, near Dossali, 5,050 ft. (B. & F. 1089 ! 1181 !).—Razani (F. 2044 !).
S.W.: Slopes of Shuidar, 7,000-9,000 ft. (F. 1586 !).
Flowers: 24-3-27 (Datta Khel).
Fruit: 13-4-30 (Dossali); 18-4-30 (Shuidar); 20-4-27 (Razani).
Distribution: Baluchistan, Kuram Valley, Afghanistan.

Iris ensata Thunb. in Trans. Linn. Soc. ii, 328.
Locality: *N.W.*: Boya (B. & F. !).
Distribution: W. Himalaya, 5,000-9,000 ft., temperate Asia.

***Iris pumila** L. Sp. Pl. 38.
Locality: *S.W.*: Razmak, in garden (B. & F. !).
Distribution: Europe, N. Asia.

AMARYLLIDACEAE.

1,050 species.—Usually tropical or subtropical.

CRINUM L.

70 species.—Tropical and subtropical regions.

***Crinum Powellii** Hort. = *C. Moorii* Hook. f. × *C. longifolium* Thunb.
Locality: *S.W.*: Razmak, planted (B. & F. !).
Distribution: Parents of Africa.

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IXIOLIRION Fisch.

2 species.—W. Asia.

Ixiolirion tataricum Schult. f. Syst. vii, 752.—*Amaryllis tatarica* Pall. Reise iii (1776) 727.—*I. Palasii* Fisch. & Mey. ex. Led. Fl. Ross. iv (1842-1852) 116.—*I. montanum* Kunth Enum. Pl. v (1850) 817.—*I. Ledebouri* Fisch. & Mey. in Bong & Mey. Suppl. Fl. Alt. no. 293.—*I. montanum* Herb. Amar. (1837) 125, t. 20, f. 3.

We have united *I. montanum* and *I. Pallasii* under the much older specific name *tatarica*. The differences between the two species mentioned by Boissier are very variable. As to the anthers Gilliat Smith and Turril mention a specimen from Persia with the anthers 6 mm. long and another measuring 3.5-4 mm. [Kew Bull. (1930) 487].

Locality: *N.W.*: Near Miram Shah village, in a wheat field (B. & F. 518 ! 519 !).

S.W.: Razmak, gravel-plain, 6,800 ft. (B. & F. 1707 ! 1708 !).—N. of Razmak, on way to Springs, on gravel, 6,700-7,300 ft. (B. & F. 1768 ! 1805 !, F. 1624 !).—Very rare.

Flowers: 28-3-30 (Miram Shah); 24-4-30 (Razmak); 25-4-30 (Razmak); 8-5-27 (Razmak).

Young fruits: 24-4-30 (Razmak).

Distribution: Baluchistan, Kuram Valley, Afghanistan, Persia to Asia Minor, Soongaria, Siberia.

NARCISSUS (Tourn.) L.

40 species.—Europe, Mediterranean, Asia.

***Narcissus poeticus** L. Sp. Pl. 289.

Vernacular name: Poet's Narcissus, Pheasant's Eye.

Locality: *N.W.*: Miram Shah, garden, 3,150 ft., doing well (B. & F. 24 !).

Flowers: 19-3-30 (Miram Shah).

Distribution: Mediterranean region.

LILIACEAE.

2,700 species.—Cosmopolitan.

ASPARAGUS L.

120 species.—Europe, temperate and tropical Asia and Africa.

Asparagus gracilis Royle Ill. i, 393.

Locality: *S.W.*: Sarwekai (F. 4006 !).

Distribution: Punjab, Baluchistan.

Asparagus capitatus Baker in Journ. Linn. Soc. xiv, 607.

Vernacular name: Gadavanga (Mashudi).

Locality: *N.W.*: Miram Shah (F. 1383 ! 1399 !).

S.W.: Sarwekai (F. 3902 !).—Sarwekai to Dargai (F. 3706 ! 3709 !).—Wana (F. 3892 !).

Tank: Near Tank (J. Williams 7212 ! 7919 ! 9189 ! 9190 !).

Flowers: 22-6-27 (Sarwekai).

Fruit: 2-7-1888 (Tank).

Distribution: Foot of W. Himalaya, 1,000-3,000 ft., Nilgiris.

Asparagus dumosus Baker in Journ. Linn. Soc. xiv, 609.

Vernacular name: Bzachoa, Gadhavanga (Waziri).

Locality: *N.W.*: Datta Khel, open stony plain (F. 1295 !).—Boya (F. 1462 !).—Chasmai River, rocky bank (B. & F. 862a !).—W. of Spinwam Fort, gravel, 2,650 ft. (B. & F. 862 !).

Distribution: Sind, Baluchistan.

Uses: Eaten by camels and goats.

Asparagus racemosus Willd. Sp. Pl. ii, 152.

Vernacular name: Gadavanga, Gadangava.

Locality: *N.W.*: Datta Khel (F. 1318 !).—Miram Shah (F. 1449 !).—N. of Spinwam Fort on disintegrating limestone hill, 2,650 ft. (B. & F. 819 !).

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—W. of Spinwam, on hill, 2,650 ft. (B. & F. 449 !).—On slope of Chota Darweshta, 3,000-4,800 ft. (B. & F. 751a !).—N. of Dossali Fort, stony plain, 4,900 ft. (B. & F. 991 !).—2 miles N. of Dossali Fort, 5,150 ft. (B. & F. 1138 !).—Razani (F. 2878 !).

S.W.: Sararogha (F. 47 ! 75 !).

Distribution: Tropical and subtropical India and Ceylon, Himalaya up to 4,000 ft., Baluchistan, tropical Africa, Java, Australia.

Asparagus ascendens Roxb. Fl. Ind. iii (1832) 153.

Locality: *N.W.*: E. of Miram Shah Fort, hill (B. & F. 565 !).

S.W.: N. of Razmak towards Springs, 6,700-7,300 ft. (B. & F. 1758 !).—Jandola, open stony ground and nalas (F. 671 !).—Along Tank River (F. 712 !).

Flowers: 26-5-27 (Jandola).

Fruit: 24-5-27 (Jandola).

Distribution: Rohilkhand, W. Himalaya, Punjab, Afghanistan.

Asparagus trichophyllus Bunge Enum. Chin. bor. 65.

Vernacular name: Gadawanya (at Razani); Gadangava (at Sararogha).

Locality: *N.W.*: Datta Khel village, 4,700 ft. (B. & F. 1437 !).—N. of Boya Fort towards Tochi River, 3,550 ft. (B. & F. 89 !).—Shewa Post, bed of Volam River (B. & F. 908 !).—N. of Dossali Fort, in nala, 4,900 ft. (B. & F. 1266 !).—Razani (F. 2056 !).

S.W.: Sararogha (F. 178 !).

Distribution: Afghanistan, Armenia, S.E. Russia, Soongaria, Turkestan, N. China.

Asparagus monophyllus Baker in Journ. Linn. Soc. xiv, 604.

Vernacular name: Gadanggoa (Waziri).

Locality: *N.W.*: Miram Shah (F. 965 ! 986 !).

Distribution: Baluchistan.

Asparagus verticillatus L. Sp. Pl. 450; Boiss. Fl. Or. v, 339.

Locality: *N.W.*: Miram Shah (F. 288 !).

Distribution: Persia, Orient, S. Europe, W. Russia.

Asparagus scaber Brign. Fasc. Forojul. 92; Boiss. Fl. Or. v, 336.

Locality: *S.W.*: Jandola, open stony ground and nalas (F. 637 !).

Distribution: Caucasus, Mediterranean, Siberia.

Asparagus? acutifolius L. Sp. Pl. 449; Boiss. Fl. Or. v, 337.

Locality: *S.W.*: Jandola, along Tank River (F. 722 !).

Distribution: Mediterranean.

EREMURUS Bieb.

20 species.—Alpine W. and Central Asia.

Eremurus persicus Boiss. Diagn. ser. 1, vii, 119; Fl. Or. v, 327.

Vernacular name: Khezi (Waziri).

Locality: *N.W.*: Near Dossali Fort, highest point of Picket no. 1 (B. & F. 1074 !).

Flowers: 11-4-30 (Dossali).

Distribution: Baluchistan, Persia.

Eremurus Aitchisoni Baker in Journ. Linn. Soc. xviii, 102.

Vernacular name: Pioz (Waziri).

Locality: *N.W.*: W. of Spinwam Fort, on slope of Chota Darweshta (B. & F. 738 !).

Distribution: Kuram Valley.

ALLIUM (Tourn.) L.

325 species.—N. hemisphere.

Allium Schœnoprasum L. Sp. Pl. 432.—*A. sibiricum* Linn. Mant. 562.

Vernacular name: Yovrai (Waziri).

Locality: *N.W.*: In bed of Khunai River below Razani, 5,050 ft. (B. & F. 1132 !).—Bed of Khunai River above Dossali, 5,000 ft. (B. & F. 1132 !).

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S.W.: In gravel on way to Springs N. of Razmak, 6,750-7,300 ft. (B. & F. 1769 !).
Flowers & Fruit: 12-4-30 (Razani, Khunai River); 25-4-30 (Razmak).
Distribution: Baluchistan, Orient.
Uses: Bulb eaten.

Allium rubellum M. Bieb. Fl. Taur. Cauc. i, 264.—*A. leptophyllum* Wall. Cat. 5073A.
Vernacular name: Garanai Pioz (Waziri).
Locality: *N.W.*: Datta Khel Fort, on gravel plain, 4,600 ft. (B. & F. 612 !).
S.W.: Pre Ghal (Hay).—Near Palosina (Stewart).
Flowers: September 1860 (Palosina, Pre Ghal).
Distribution: W. Himalaya, from Kashmir to Kumaon, 1,500-8,000 ft., Punjab. Westwards to the Ural, and in Siberia.

Allium rubellum M. Bieb. **var. grandiflora** Boiss. Fl. Or. v., 253.—*A. Griffithianum* Boiss. Diagn. ser. 2, iv, 117.—*A. vulcanicum* Boiss. in Pl. Kotsch. Pers. Bot. No. 49.
Vernacular name: Spai khukh (Williams); Pioziki, Piozgai (Waziri).
Locality: *N.W.*: Bed of Sua Algad near Khajuri Post, in gravel and sand, 2,250 ft. (B. & F. 373 !).—Khajuri, bed of Tochi River, in sand (B. & F. 412 !).—S. of Miram Shah, gravel plain, 3,150 ft. (B. & F. 481 !), in cultivation (F. 385 !).
S.W.: (J. Williams 9188 !).—Razmak (F. 3038 !).
Tank (J. Williams !).
Flowers & Fruit: 26-3-30 (Khajuri); 28-3-30 (Miram Shah); 14-4-27 (Miram Shah); 1-5-1891 (Tank); 2-5-27 (Razmak); 20-6-1888 (S.W.).
Distribution of var.: Kashmir, 5,000-7,000 ft., Baluchistan, Afghanistan, westwards to Persia.

Allium umbilicatum Boiss. Diagn. ser. 2, iv, 113; Fl. Or. v, 251.
Locality: *N.W.*: Near Datta Khel village, 4,600 ft. (B. & F. 1516 !).
Flowers with bulbils: 17-4-30 (Datta Khel).
Distribution: Baluchistan, Kuram Valley.

Allium cupani Raf. Car. (1818) 86; Boiss. Fl. Or. v, 265.
Locality: *N.W.*: Loargai Narai, 6,600 ft. (B. & F. 1311 !).
S.W.: N. of Razmak, towards Springs, on gravel, 6,700-7,300 ft. (B. & F. 1769 !).
Flowers: 16-4-30 (Loargai Narai); 25-4-30 (Razmak).
Distribution: S. Europe, Mediterranean.

Allium djimilense Boiss. Fl. Or. v, 265.
Locality: *N.W.*: N. of Dossali Fort, on stony plain, 4,900 ft. (B. & F. 982 !).
Flowers: 10-4-30.
Distribution: Pontus.

Allium cassium Boiss. Diagn. ser. 1, xiii, 28.
Locality: *N.W.*: W. of Spinwam, slopes of Chota Darweshta, 2,750-3,000 ft. (B. & F. 704 !).
Flowers: 2-4-30 (Spinwam).
Distribution: Syria, Cilicia.

Allium moschatum L. Sp. Pl. 427.
Vernacular name: Spipekh, Spikikh (Waziri).
Locality: *N.W.*: Near Miram Shah, right bank of Chasmai River, on sandy clay, 3,100 ft. (B. & F. 236 !).—Loargai Narai, in a tuft of grass, 6,600 ft. (B. & F. 1322 !).
Distribution: Persia, Caucasus, S. Europe.

Fritillaria L.

50 species.—N. temperate regions.

Fritillaria imperialis L. Sp. Pl. 303.
Sometimes the bracts are broadly lanceolate. The flowers are generally shorter than described.

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Locality: *S.W.*: Shuidar, 7,000-9,000 ft. (F. 1462 ! 1604 ! 1606 !).
Flowers: 18-4-30 (Shuidar).
Distribution: W. Himalaya, 7,000-9,000 ft., Afghanistan, Persia, Kurdistan.

Fritillaria imperialis L. **forma uniflora** Blatter.
Locality: *S.W.*: Shuidar, 7,000-9,000 ft. (F. 1605 !).
Flowers: 18-4-30 (Shuidar).

TULIPA L.

50 species.—N. temperate regions of the Old World, especially on the steppes of Central Asia.

Tulipa chrysantha Boiss. in Kotsch. Pl. Pers. Bor. Exsicc. 1846, no. 17; Fl. Or. v, 193.
Vernacular name: Sundai (Waziri).
Locality: *N.W.*: Near Miram Shah village, in wheat field together with *Iris* (B. & F. 529 !).—Datta Khel (F. 1187 ! 1193 ! 1194 !).—Razani (F. 1190 ! 2886 ! 2927 ! 2932 ! 2935 ! 2937 !).—Chota Darweshta, on stony slope, 2,750 ft. (B. & F. 722 !).—Boya, on stony slope S. of Boya Post (F. 558 !).
S.W.: N. of Razmak, near Springs, 7,700 ft. (B. & F. 1804 !).—Razmak (F. 2020 ! 2027 ! 3120 !).
Flowers: 24-3-27 (Datta Khel); 28-3-30 (Miram Shah); 8-4-27 (Boya); 14-4-30 (Razmak); 19-4-27 (Razani); 25-4-30 (Razmak); 30-4-27 (Razmak); 8-5-27 (Razmak).
Distribution: Punjab, Salt Range, Baluchistan, Afghanistan, Turkestan, Persia, Central Asia.

Tulipa montana Lindl. Bot. Reg. t. 1106.
Vernacular name: Shundai (Waziri).
Locality: *N.W.*: Dossali, in nala and on slope leading to Picket Hill (B. & F. 1278 !).
Old fruit of previous year: 15-4-30 (Dossali).
Distribution: Afghanistan, Baluchistan, Persia, Mesopotamia, Syria, Palestine.

Tulipa Fernandezii [1] Blatter *sp. nov.* [*Liliacea. Refert T. porphyreo-chrysantham* Blatter, *sed distinguitur caule duplo maiore, 24 cm. attingente, pedunculo rubro, foliis pedunculo semper multo brevioribus, omnibus acuminatis, inferioribus lanceolatis, superioribus linearibus, phyllis perigonii externis oblongo-acutis vel oblongo-apiculatis (non acuminatis), internis oblongo-obtusis (non obovatis), omnibus ad 19 mm. longis, ca. 7 mm. latis, staminibus 8 mm. longis, dimidium perigonii attingentibus, filamentis quam antherae brevioribus.*]

Bulbus ovatus, 12×8 mm., rufo-brunneus, intus rufescenti-villosus. Caulis cum pedunculo usque ad 24 cm. altus, erectus, glaber. Folia 4, pedunculo semper multo breviora, omnia acuminata, erecta, inferiora lanceolata, ad 12 cm. longa, 9 mm. lata, superiora lanceolato-linearia, omnia margine anguste cartilaginea, subundulata. Pedunculus ruber. Phylla perigonii ad 19 mm. longa, ca. 7 mm. lata, externa quidem oblongo-acuta vel oblongo-apiculata (non acuminata), intus flava, extus rubra, interna oblongo-obtusa (non obovata) utrimque flava. Stamina 8 mm. longa, dimidium perigonii attingentia; filamenta antheris aliquantulum breviora. Capsula oblongo-cylindrica, angustior versus apicem.

Bulb ovate, 12×8 mm., dark brown, inside near the top rufescent-villous. Stem, including the peduncle up to 24 cm. high, erect, glabrous. Leaves 4, always much shorter than the peduncle, all acuminate, erect, more or less strict, the lower ones lanceolate, up to 12 cm. long, 9 mm. broad, the upper ones lanceolate-linear, all with a narrowly cartilaginous margin, subundulate. Peduncle red. Perigone-leaves up to 19 mm. long, ca. 7 mm. broad, the outer ones oblong-acute or oblong-apiculate (not acuminate), inside yellow, outside red, the inner ones oblong-obtuse (not obovate), yellow on both sides. Stamens 8 mm. long, reaching half-way up the perigone; filaments slightly shorter than the anther. Young capsule oblong-cylindric, getting thinner towards apex.

[1] After Mr. Joseph Fernandez who, on several occasions, made valuable collections in Waziristan.

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Vernacular name: Sundai, Shandi gul (Waziri).
Locality: *N.W.*: Hillside near Anghm village (Lt. Meynell 991a ! 999 !).
S.W.: On slope of Shuidar, 9,000-11,000 ft. (F. 1526 ! 1526a !).
Flowers & young fruit: 18-4-30. The snow had just disappeared from the locality.

Tulipa porphyreo-chrysantha Blatter *sp. nov.* [*Liliacea, persimilis Tulipae chrysanthae Boiss. sed distinguitur statura minore, foliis erectis variantibus, 4-5, phyllis perigonii exterioribus intus aureis, extus purpureis, interioribus aureis, absentia ad basim macularum brunneārum, staminibus longioribus perigonium dimidium attingentibus.*]

Caulis cum pedunculo gracilis, ad 13 cm. altus, glaber. Folia 4-5, glauca, distantia, elongata, latitudine variantia erecta, lanceolata, lanceolato-linearia, lineari-acuminata, latiora undulata et margine cartilaginea, breviora vel longiora pedunculo. Flos mediocris unicus ad 27 mm. longus, erectus, campanulatus; phylla exteriora aurea intus, purpurea extus, oblongo-ellipsoidea, acuta vel breviter acuminata, interiora aurea, anguste obovata, obtusa. Stamina perigonio duplo breviora, 13 mm. longa, aurea filamenta aliquantulum antheris longiora vel iis aequilonga, glaberrima. Bulbum et fructum non vidi.

Stem, including peduncle, up to 13 cm. high, glabrous. Leaves 4-5, glaucous, distant, elongate, varying in breadth, erect, lanceolate, lanceolate-linear, linear-acuminate, the broadest ones undulate with a cartilaginous margin, shorter or longer than the peduncle. Flower medium-size, 1, up to 27 mm. long, erect, campanulate; outer perigone-leaves golden-yellow inside, purple outside, oblong-ellipsoid, acute or shortly acuminate, inner ones golden-yellow, narrowly obovate, obtuse. Stamens reaching half-way up the perigone, 13 mm. long; filaments yellow, slightly longer than the anthers, glabrous. Bulb and fruit not seen.

Vernacular name: Shandi gul (Waziri).
Locality: *N.W.*: Hillside near Anghm village (Lt. Meynell 999 ! type, 999a ! cotype).
Flowers: April 1930.

Gagea Salisb.

30 species.—N. temperate regions of Old World.

Gagea reticulata Schult. f. Syst. vii, 542.
Locality: *N.W.*: N. of Dossali Fort, in stony nala, 4,900 ft. (B. & F. 1287 ! 1297 !).
S.W.: N. of Razmak, gravel plain, 6,750 ft. (B. & F. 49 !).
Fruit: 15-4-30 (Dossali).
Distribution: Afghanistan, Orient, S. Europe, N. Africa, Turkomania, Turkestan.

Gagea reticulata Schult. f. Syst. vii, 542 **var. tenuifolia** Boiss. Fl. Or. v, 208.
Locality: *N.W.*: Hills E. of Miram Shah, 3,600 ft. (B. & F. 577 !).—Spinwam, disintegrating limestone hill, 2,650 ft. (B. & F. 813 !).—Shewa Post, right bank of Kuram River (B. & F. 953 !).—E. of Miram Shah, gravel plain, 3,150 ft. (B. & F. 162 !).—N. of Dossali (B. & F. 1047 !).
S.W.: N. of Razmak, towards Springs, on gravel, 6,700-7,300 ft. (B. & F. 1782 !).—S.W. of Razmak on hill, 6,900 ft. (B. & F. 1944 !).
Flowers: 4-4-30 (Spinwam); 10-4-30 (Dossali).
Flowers & Fruit: 22-3-30 (E. of Miram Shah); 29-3-30 (E. of Miram Shah); 25-4-30 (Razmak).
Distribution of var.: Persia to Egypt.

Gagea lutea Schult. f. Syst. vii, 538.
Locality: *S.W.*: Razmak, on gravel and sand, 6,750 ft. (B. & F. 48 !).
Flowers: 20-3-30 (Razmak).
Distribution: W. Himalaya, westwards to the Atlantic, N. Asia.

Gagea persica Boiss. Diagn. ser. 1, vii (1846) 108 **var. ebulbillosa** Boiss. Fl. Or. v, 210.
Locality: *S.W.*: Razmak (B. & F. !).
Distribution of var.: Afghanistan, Baluchistan, Persia.

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COLCHICUM L.

45 species.—Europe, W. Asia, N. Africa.

Colchicum luteum Baker in Gard. Chron. (1874) 33.
Locality: *N.W.*: W. of Miram Shah, moist firm sand in old river-bed, 3,150 ft. (B. & F. 5 !).
S.W.: N. of Razmak towards Springs, on open stony ground, 6,700-7,300 ft. (B. & F. 1781 !, F. 1548 !).
Fruit: 19-3-30 (Miram Shah); 25-4-30 (Razmak); 10-5-27 (Razmak).
Distribution: W. temperate Himalaya, 4,000-7,000 ft., Afghanistan, Turkestan.

MERENDERA Ram.

10 species.—Mediterranean, Abyssinia, Afghanistan.

Merendera persica Boiss. & Kotsch. Diagn. xiii, 37; Fl. Or. v, 169.
Locality: *S.W.*: Wana, 4,500 ft. (Duthie's Collect. 15662 !).—Razmak, 6,500 ft. (D. G. Lowndes F. 3 !).
Flowers: 4-5-1895 (Wana).
Distribution: Punjab, Salt Range, Afghanistan, Persia.

JUNCACEAE.

300 species.—In damp and cold places, temperate and arctic regions, tropical mountains.

JUNCUS.

225 species.—Cosmopolitan.

Juncus glaucus Ehrh. Beitr. vi, 83.
Locality: *S.W.*: Near Kaniguram (Stewart).—Wana (Duthie's Collect. 15668 !).
Distribution: W. Himalaya, 6,000-9,000 ft., from Kashmir to Nepal, Nilgiris, Ceylon, N. Asia, N. Africa, Europe.

Juncus lampocarpus Ehrh. Calam. no. 126.—*J. articulatus* L. Sp. Pl. i, 327.
Locality: *S.W.*: Near Kaniguram (Stewart).
Distribution: N.W. India, W. Himalaya, 7,000-14,000 ft., N. temperate regions.

PALMAE.

1,500 species.—Tropical and subtropical regions.

*PHOENIX L.

12 species.—Warm Africa, Asia.

***Phoenix dactylifera** L. Hort. Cliff. 482.
Vernacular name: Edible Date Palm; Khajura (Waziri); Shewa (Pu.).
Locality: *N.W.*: Miram Shah, cultivated (F. 801 !).
S.W.: Zam Valley above Khirgi, rare (Stewart).
Tank (Stewart).
Distribution: N. Africa, S.W. Asia, India.

NANNORHOPS H. Wendl.

1 species.—N.W. India, Persia.

Nannorhops Ritchieana H. Wendl. in Bot. Zeit. (1879) 148.—*Chamaerops Ritchieana* Griff. in Calc. Journ. Nat. Hist. v, 342.
Vernacular name: Mazrai (Waziri); Maizurrye (Pu.); Pish, Mazari, Dhora (Baluch.).
Locality: *N.W.*: Boya (F. 423 ! 1464 ! 1520 !).—Miram Shah (F. 489 ! 1497 !).—Razani (F. 3015 !, Stewart).
S.W.: Sararogha (F. 177 ! 620 !).—Tenai Post (F. 4015 ! 4017 !).—Wana (F. 3414 !).—Between Sarwekai and Dargai Post on mountain (F.

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3450 !).—Sarwekai (F. 3982 !).—On hills N. of Anai Gorge, abundant (Stewart).
Flowers: June 1927.
Uses: Used for making ropes, sandals and mats.
Distribution: Sind, Baluchistan, Waziristan, Punjab, Afghanistan.

TYPHACEAE.

Typha L.

12 species.—Temperate and tropical regions, in marshes.

Typha angustata Chaub. & Bory Exped. Scient. Moorée Bot. 338.
Vernacular name: Rukh (Pu.); Dilla (Waziri).
Locality: *N.W.*: Razani, in swamp (F. 2181 !).—Dwa Warkha (Stewart).
S.W.: Jandola, along bank of Tank River (F. 763 !).—Sarwekai (F. 3907 !).—Tenai Post, along stream, on way to Spin (F. 4036 !).—Dargai Post, in marsh (F. 3738 !).—Wana, along river and in swamp (F. 3598 !).
Tank: In ravine S. of Tank (Stewart).
Flowers: 25-5-27 (Jandola); 22-6-27 (Dargai Post).
Distribution: N. India from Kashmir to Manipur and southwards to Sind and Coromandel, N. Asia, N. Africa, S. Europe.
Uses: Leaves used for thatch at Tank and other places (Stewart).

ARACEAE.

1,000 species.—Tropical and temperate regions.

Pistia L.

1 species.—Tropical and subtropical regions.

Pistia Stratiotes L. Sp. Pl. (1753) 963; Roxb. Corom. Pl. iii, 63, t. 269, Fl. Ind. iii, 131; Boiss. Fl. Or. v, 45.
Locality: *S.W.*: Razmak, 6,300 ft. (F. 1653 !. 1655 !. 1658 !. 2028 !).
Distribution: All the warm regions of the earth.
Flowers: April.

Arisaema Mart.

105 species.—Asia, Abyssinia, N. America.

Arisaema flavum Schott. Prodr. (1860) 40.—*Arum flavum* Forsk. Fl. Aeg.-Arab. (1775), p. cxx, no. 525, 157.—Fruit scarlet.
Locality: *S.W.*: Razmak, at base of small bushes, plentiful, 6,500 ft. (Capt. Lowndes 8 !).
Flowers & Fruit: July 1932.
Distribution: Subtropical W. Himalaya, Simla, Garhwal, Afghanistan, Kuram Valley, Arabia, Abyssinia, Eritrea.

LEMNACEAE.

18 species.—Free-swimming perennial water-plants.

Lemna L.

6 species.—Cosmopolitan.

Lemna minor L. Sp. Pl. 976.
Locality: *N.W.*: Boya, in Tochi River (F. 525 !).
Distribution: Cosmopolitan in temperate and tropical regions.

ALISMACEAE.

75 species.—Cosmopolitan.

Alisma L.

1 species.—N. temperate regions, Australia.

Alisma plantago L. Sp. Pl. (1753) 342.
Locality: *S.W.*: Kaniguram (Stewart).—N. of Razmak, below Springs

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7,700 ft. (B. & F. 1856 !).—Wana Plain, along stream (F. 3400 ! 3412 !).—E. of Wana Fort, in marsh (F. 3402 !).

Flowers: 18-6-27 (Wana).

Distribution: Lower Himalaya, 1,000-7,000 ft., from Kashmir to Manipur and Burma, N. and S. temperate regions.

SAGITTARIA Rupp. ex L.

33 species.—Temperate and tropical regions.

Sagittaria sagittifolia L. Sp. Pl. (1753) 993.

Locality: *S.W.*: Wana Plain, marsh (F. 3455 !).

Distribution: India, Afghanistan, Mesopotamia, Europe, N. Asia, N. America.

POTAMOGETONACEAE.

120 species.—Cosmopolitan.

POTAMOGETON (Tourn.) L.

90 species.—Cosmopolitan.

Potamogeton indicus Roxb. Fl. Ind. i (1832) 452.

Locality: *S.W.*: Jandola, bed of Tank River (F. 749 !).—Wana, marsh (F. 3522 ! 3565 !).

Flowers & Fruit: 25-5-27 (Jandola).

Distribution: Throughout the plains of India, Ceylon, Malay and Sandwich Islands.

RUPPIA L.

1 species.—Temperate and subtropical regions.

Ruppia maritima L. Sp. Pl. (1753) 127.

Locality: *N.W.*: Boya, Tochi River (F. 524 !).—Miram Shah (F. 350 !).

Fruit: 7-4-27 (Boya).

Distribution: Europe, N. Africa, tropical Asia, N. America.

ZANICHELLIA Mich. ex L.

1 species.—Cosmopolitan.

Zanichellia palustris L. Sp. Pl. (1753) 669.

Vernacular name: Shan shabae (Waziri).

Locality: *N.W.*: Boya, Tochi River (F. 1419 ! 1421 !).—Miram Shah village, in a pond, 3,150 ft. (B. & F. 512 !).—Near Chasmai River, in muddy pool, 3,150 ft. (B. & F. 331 !).

Flowers & Fruit: 24-3-30 (Chasmai River); 27-3-27 (Boya).

Distribution: Cosmopolitan, except Australia.

(*To be continued*).

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THE HYDERĀBĀD STATE ORNITHOLOGICAL SURVEY.

BY

SÁLIM ALI.

With Notes by HUGH WHISTLER.

PART V.

(*With three plates*).

(*Continued from page* 142 *of this Volume*).

FAMILY: PANDIONIDÆ.

Pandion haliaëtus (Linn.) The Osprey.

Falco haliaëtus Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 91—Europe, restricted to Sweden.

No specimen obtained.

A single bird (or birds?) was frequently observed at the junction of the Godāvari and Kinārsāni Rivers at Borgampād between 1 and 7 November. Col. Sparrow also has sight records from Bhiknūr, Hūssein Sāgar Tank (Hyderābād City) and elsewhere between 25 November and 10 March.

Sarcogypus calvus (Scopoli). The Black, Pondicherry or King Vulture.

Vultur calvus Scopoli, Del. Flor. et Faun. Insubr., vol. ii (1786), p. 85—Pondicherry.

No specimen obtained.

Noted at Manānūr, Borgampād, Nelipāka, Āsifābād, Kandahār, Deglūr, Kaulās and Kannad.

The Black Vulture is common everywhere, but not numerous. Two or three may invariably be seen in every vulture gathering at wayside carcases, and the density of their population relative to the other species probably bears the same ratio.

William Davidson (S.F., x) writes: 'I too have noticed what Jerdon says about the fear shown by *Gyps bengalensis* and *Gyps indicus* of this species'. It is curious that my experience has been quite the opposite. I have always found this so-called King Vulture to be the most cowardly member of the fraternity that usually gathers at a feast, keeping itself aloof of the scrimmage, only occasionally venturing forward in obvious fear and trembling to tug at a gobbet and withdrawing hurriedly when overwhelmed by the press. The photograph published with Part I of this paper (J.B.N.H.S., xxxvi, 368) depicts a King Vulture on the extreme left in its typically cowardly attitude.

Breeding: Col. Sparrow took a fresh egg at Navipēt (?) on 3-1-14 and found young at Rāmākapēt (?) on 31-1-14.

Gyps fulvous (Hablizl) subspecies? The Indian Griffon Vulture.

Vultur fulvous Hablizl, Neue Nord. Beytro., vol. iv (1783), p. 58—Mtns. of Gilan, N. Persia.

No specimen obtained.

Noted at: Manānūr, Nelipāka, Kandahār, Deglūr, Kaulās, Aurangābād, Ūtnoor, Hyderābād City and Environs, and elsewhere.

This is one of the commonest vultures, probably even more so than the White-backed species. At Daulatābād Fort (Aurangābād Dist.) numbers were observed on the cliffs at the base of the battlements, and this appeared to be an admirable nesting site. At the time, however, the birds were not breeding. (26 April).

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Gyps indicus (Scopoli) subspecies? The Long-billed Vulture.

Vultur indicus Scopoli, Del. Flor. et Faun. Insubr., vol. ii (1786), p. 85—Pondicherry.

No specimen obtained.

Noted at: Manānūr, Kaulās, Ūtnoor and elsewhere.

Common, sharing the honours almost evenly as regards numbers with the White-backed Vulture, and present at every wayside carcase. Also observed at a panther's kill in deciduous forest.

Breeding: Col. Sparrow has taken eggs and young in various stages at Mūlkāram and Eswantarāopēt between 7 January and 16 March.

Pseudogyps bengalensis (Gmelin). The White-backed Vulture.

Vultur bengalensis Gmelin, Syst. Nat., vol. i (1788), p. 245—Bengal.

No specimens obtained.

Noted at: Manānūr, Borgampād, Pāloncha, Deglūr, Ūtnoor, Āsifābād, Kaulās, Hyderābād City Environs and elsewhere.

This common and familiar species is easily recognised by its white back and, in overhead flight, by the white bands across the underside of the wings.

Vultures certainly follow one another's movements when descending to a carcase. Some make a wide spiral descent while others just let themselves down through space more or less perpendicularly, wings half pulled in. The feet are always dropped dangling in descent and even when a bird is soaring high up in the heavens, such behaviour leaves no doubt as to its intentions. Before taking off from the ground they generally hop along for some distance against the wind, taking advantage of the resistance to lift them up. I have frequently observed that they will do so even if they have to turn right round and run into the face of the observer from whom they are fleeing.

Breeding: On 18 December (Āsifābād) a pair were observed in copula. During the act the birds (or female only ?) made a loud raucous grating noise very like a hoe being scraped over a cemented floor.

Col. Sparrow found nests with young at Kāmāreddi and Rāmākapēt on 28 January.

Neophron percnopterus (Linn.) subsp.? The White Scavenger Vulture.

Vultur percnopterus Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 87—Egypt.

No specimens obtained.

Noted at: Hyderābād City and Environs, Nāgar Karnūl, Manānūr, Farāhābād, Borgampād, Āsifābād, Kandahār, Deglūr, Kaulās, Aurangābad, Kannad and elsewhere.

A common and abundant species usually met with on the outskirts of towns and villages either perched on roof-tops, rocks or stakes, or goose-stepping along the ground. Besides the human ordure on which it largely feeds, it is also invariably present in small numbers at wayside carcases, timidly tugging and pulling at odds and ends whenever the coast is clear.

Breeding: On 26 March (Kaulās) a nest was located in a niche among the battlements of the ruined fort, containing two fairly hard-set eggs. They measured 61×49 and 66×54 mm. respectively. The nest was no more than a rough, flimsy and untidy pad composed of the most filthy and disreputable rags, goats' hair, dung (that looked like a hyaena's) and so forth. The parent was a close sitter and had to be moved with a stick, although it made no effort at defence subsequently. On 27 March a second nest was found in an identical situation not a hundred yards away, also a collection of the same filthy odds and ends. A fresh egg was lying smashed on a ledge about 5 ft. above the nest. On the same day a 3rd nest was discovered with the bird sitting on it, in an inaccessible niche in the ramparts at about 30 ft.

Col. Sparrow found several nests containing eggs and young (usually one or two) at Masāipēt, Trimulgherry, Eswantarāopet and elsewhere, between 20 February and 5 April. One egg on the last date was fresh.

Family: Falconidæ.

Falco peregrinus Tunstall. subsp.? The Peregrine Falcon.

Falco peregrinus Tunstall, Orn. Brit. (1771), p. 1—Great Britain.

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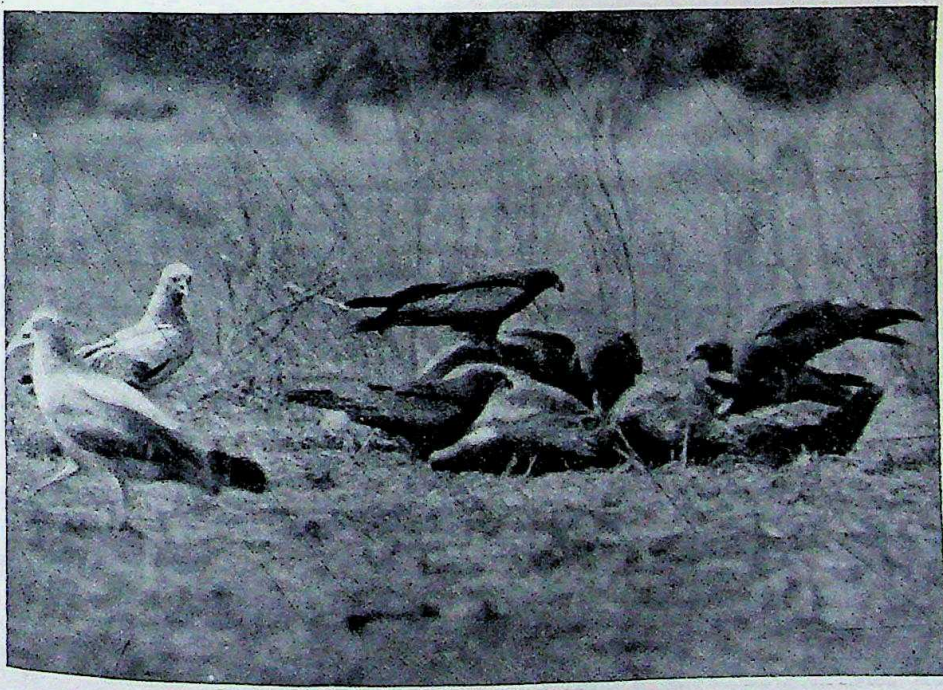
1. Scavenger Vultures (*Neophron percnopterus*).



2. Pariah Kites (*Milvus govinda*) and Neophrons at a wayside carcase.

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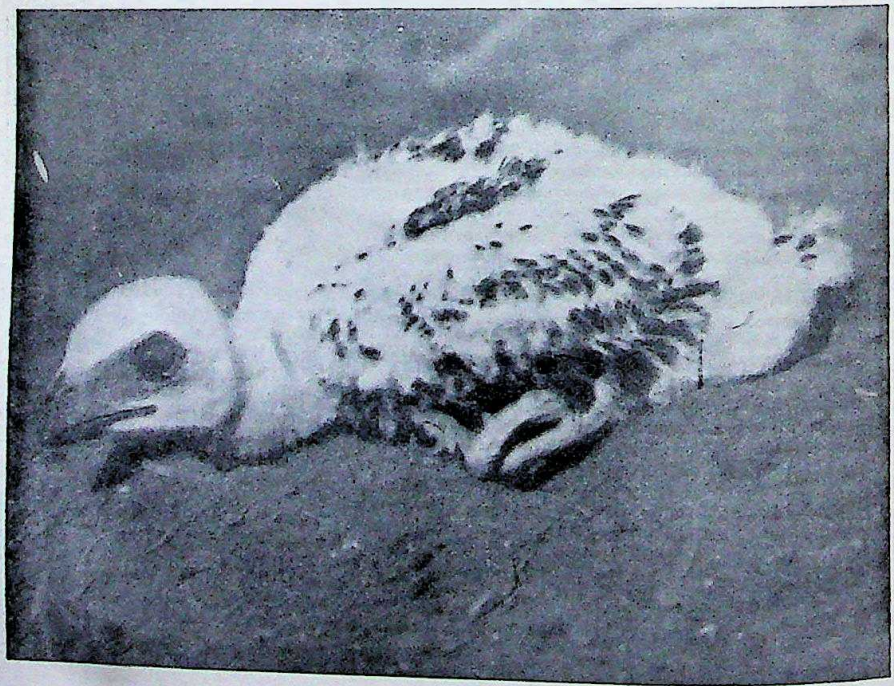
1. Scavenger Vulture on Nest (Kaulās, 26 March).



2. Downy Chick of the Crested Hawk-Eagle (Spizaetus cirrhatus), Chidor, 3 April (see description).

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No specimens obtained.

One was noted at Borgampād on 28 October 1931. Col. Sparrow has a sight record of one at Chintakani on 3-2-13.

I do not mention other sight records as I cannot be certain of my identifications of this group of birds in the field.

Falco jugger J. E. Gray. The Lagar Falcon.

Falco jugger J. E. Gray in Hardwicke's Illust. Ind. Zool., vol. ii (April 1834), pl. 26—India.

Specimens collected: 214 ♂ 1-11-31 Borgampād 160 ft.; 543 ♂ 13-3-32 Deglūr 1,300 ft.

Noted elsewhere at: Kaulās (19 March).

Iris brown; cere and circumorbital skin pale greenish-yellow to bright lemon-yellow; corneous part of bill plumbeous, tip black; legs and feet greyish-yellow to bright yellow; claws horny-black.

Only seen singly or in pairs in the neighbourhood of cultivation. No. 214 and its pair were being mobbed by crows. It uttered from time to time a shrill prolonged cry *whi-ee-eee*. No. 543 was being chivvied by a pair of Black Drongos. Its stomach contained a field rat.

The testes of the specimens were in an undeveloped condition.

Falco subbuteo Linn. subsp.? The Hobby.

Falco subbuteo Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 89—Europe, restricted to Sweden.

I did not observe this species in Hyderābād, but Cap. E. A. Butler records one shot near Jālna in his 'Tentative Catalogue of Birds in the Deccan and Southern Mahratta Country' (S.F., ix, 367-442) ca. 1881.

Falco chiquera Daudin. The Red-headed Merlin.

Falco chiquera Daudin, Traité d'Orn., vol. ii (1800), p. 121—Bengal.

No specimens obtained.

Noted at: Borgampād where a pair was worrying and chasing crows close to the village, and at Narsampēt—a solitary bird near a marsh.

Col. Sparrow saw it at Trimulgherry 6-11-12 and shot a ♂ at Jālna 21-1-11.

Cerchneis tinnunculus tinnunculus Linn. The Kestrel.

Falco tinnunculus Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 90—Europe, restricted to Sweden.

Specimens collected: 182 ♀ 29-10-31, 215 ♀ 1-11-31, 216 ♂ 2-11-31, 227 ♀ (?) 3-11-31 Borgampād 160 ft.; 318 ♂ 15-11-31 Nelipāka 160 ft.

Elsewhere noted at: Narsampēt, Mālegāon (Mrs. Tasker !); Mūkhēr, Deglūr, Kaulās.

Iris dark brown; cere and circumorbital skin lemon yellow; bill greenish-horn, black at tips; mouth greyish pink or pale pink; legs and feet bright yellow; claws black.

The Kestrel was abundant in the cultivated country at Borgampād where it was commonly seen perched singly on mounds, stones or low bushes—sometimes on the ground—in the middle or on the edge of fields and ploughed land. The fields appear to be apportioned off among the birds, and encroachment on neighbouring 'feeding territories' meets with active resistance from the rightful owner. For some reason, the birds were less numerous at Nelipāka although the country seemed identical, and at the other places their numbers were considerably less. The stomachs of the specimens contained field rats and mice, besides locusts, grasshoppers and other insects.

The familiar hovering is always accomplished with the help of wind resistance, the bird invariably facing the wind to do so.

The gonads of the specimens gave no indication as regards breeding.

In the following I only mention such of the Eagles, of the identity of which I am positive. There is no doubt that many others must also occur within the limits of this vast tract of country; but I hesitate to mention unconfirmed sight records as these can obviously be of little scientific value. If the Hyderābād Survey is resumed, I hope to be able to pay greater attention to the Birds of Prey.

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Aquila rapax vindhiana Franklin. The Indian Tawny Eagle.

Aquila vindhiana Franklin, P.Z.S. 1830-1831 (October 25, 1831), p. 114—Vindhyan Hills.

No specimens obtained by the Survey. Col. Sparrow shot two examples as follows: ♂ 9-2-11 Kārkeli (Deccan); ♂ 1-2-12 Trimulgherry.

Noted at: Borgampād, Kandahār, Kaulās, and elsewhere.

A common resident species.

At Kandahār a single individual came regularly round the camp to pick up carcases of skinned birds, and was constantly persecuted by rival kites and crows. At Kaulās one was observed picking up scraps left by vultures after a feast, in company with Scavenger and King Vultures.

Breeding: Col. Sparrow took a clutch of two eggs at Eswantarāopēt on 15 December (1913).

Davidson and Wenden (S.F., vii, 74) who found this eagle extremely abundant in the Deccan, took eggs from 26 October to 12 February.

B. Aitken (N. & E., iii, 135) found a nest in Akola (Berār) on 1 January containing a half-fledged chick. On 10 February, according to him, the same pair laid C/1 in a new nest.

Hieraëtus fasciatus (Vieillot). Bonelli's Eagle.

Aquila fasciata Vieillot, Mem. Linn. Soc., Paris, vol. ii (2), 1822, p. 152—Montpelier, France.

Not met with by the Survey.

Breeding: Col. Sparrow took a clutch of 2 eggs at Navipet (?) on 2 January (1914).

Davidson and Wenden (S.F., vii, 74) found a single newly hatched chick on 10 February, and took slightly set eggs on 13 January at Kassigaum (presumably in the Bhīma Valley, Deccan). They saw eyries with young also at Dhotri and Subjar.

Spizaëtus cirrhatus cirrhatus (Gmelin). The Crested Hawk-Eagle (Telūgū: *Namli-pūri-gadda*).

Falco cirrhatus Gmelin, Syst. Nat., vol. i, pt. i (1788), p. 274—India.

Specimens collected: 321 ? 15-11-31 Nelipāka 160 ft.; 375 ♀ 26-11-31 Pāloncha 300 ft.; 668 ♀ 7-4-32, 680 ♀ (juv.) Utnoor 1,250 ft.

Elsewhere noted at: Āsifābād.

Iris pale khaki to bright orange yellow, apparently varying with age; cere greyish to greenish-brown; corneous portion of bill horny-black; gape and eyelids greyish-green; feet lemon yellow; claws horny-black. *In nestling*: Iris greyish-brown; cere slaty-grey; bill horny-black; gape greenish-grey; bare skin round and in front of eyes, slaty-grey; mouth pink; feet pale greenish-grey; claws horny-black.

The Crested Hawk-Eagle is not uncommon in the forested tracts of the State. It has a loud high-pitched cry: '*Ki-ki-ki-ki-ki-ki-ki-ki-ki-kece*' beginning short, rising in a crescendo and ending in a scream.

The stomach of No. 321 contained a large lizard (*Calotes versicolor*), and the bird was exceedingly fat. According to the local Gonds, this species is very destructive to hares and young peafowl.

Breeding: No. 668 (7 April) was shot off a nest—a collection of sticks—in the fork of a straight Mhowa tree in deciduous forest, at a height of about 60 ft. Its ovaries were reverting to normal condition and a conspicuous incubation patch was present. The nest contained a chick in white fluffy down (No. 680). It was kept alive for two days on carcases of skinned birds, swallowing an entire Munia (*Amandava*) at a time. It also drank greedily. As far as I know the nestling of this eagle has not before been described. The following is a detailed description of No. 680: A thick rudimentary tuft of white down at nape, where crest in adult; brown primaries sprouting, also bastard wing quails, secondaries, upper wing-coverts, dark brown scapulars, upper tail-coverts and rectrices. A central tract of brown feathers down the back of the neck to midway between the scapulars, and two tracts of fulvous-brown feathers on either side of the breast.

The ♂ parent did not put in an appearance during the time the nest was being climbed up to and handled.

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Col. Sparrow has taken 10 clutches of a single egg each in every stage of incubation, at Eswantarāopēt between 21 February and 3 May.

According to Vidal (N. & E., iii, 147) the Crested Hawk-Eagle breeds in South Konkan from December to April, during which time he examined 32 nests. The favourite month is said to be January. The species is not mentioned in D. & W's list for the Deccan.

Circaëtus gallicus (Gmelin). The Short-toed Eagle.

Falco gallicus Gmelin, Syst. Nat., vol. i, pt. i (1788), p. 259—France.

Not met with by the Survey.

Breeding: Col. Sparrow has taken 3 clutches of a single egg each, at Eswantarāopēt between 28 January and 20 February.

Davidson and Wenden (S.F., vii, 74) describe it as not uncommon in the bare parts of the Sholāpūr District from September to the beginning of April. They did not observe it breeding.

Hæmatornis cheela (Latham) subsp.? The Crested Serpent Eagle.

Falco cheela Latham, Index Ornith., vol. i (1790), p. 14—India.

Noted in the environs of Hyderābād City (25 September) and at Nelipāka (9 November). Apparently rather an uncommon species.

Butastur teesa (Franklin). The White-eyed Buzzard-Eagle.

Circus teesa Franklin, P.Z.S. 1830-1831 (25 October, 1831), p. 115—Between Calcutta and Benares and in the Vindhyan Hills between the latter place and Gurra Mandela.

Specimen collected: 99 ♂ 11-10-31 Manānūr 2,000 ft.

Elsewhere noted at: Borgampād, Narsampēt, Kandahār, Deglūr, Utnoor, Itchora, Kannad.

Iris pure China white; base of lower mandible bright yellow, rest of bill horny-brown; mouth pale pinkish; legs and feet bright yellow; claws black.

A commonly distributed species frequenting both open country and deciduous forest. At Borgampād it was commonly observed perched singly on small mounds or bush-tops in or about cultivation, while in the deciduous forest between Itchora and Utnoor it was noted as the commonest bird of prey.

The stomach of the specimen contained two large *Mabuia* (*carinata* ?) lizards, 1 locust (apparently *Acridium peregrinum*), 1 large green grass-hopper (species?) and remains of Katydids and other grasshoppers. There was also found a tangle of endoparasitic worms, sent for determination to the Berlin University Zoological Museum.

Breeding: The testes of the specimen (11 October) were in non-breeding condition. On 4 April a nest was located in the fork of a straight *Boswellia serrata* tree in deciduous jungle, at a height of about 25 ft. The owner was observed carrying a lizard to the nest which obviously contained young. Unfortunately it was inaccessible and could not be examined.

Col. Sparrow, who found this species very common in the jungles about Eswantarāopēt, has taken numerous clutches of eggs in varying stages of freshness and incubation between 30 March and 5 May. Most nests contained two eggs, but some had three and occasionally there was only one.

B. Aitken (N. & E., iii, 160) found it breeding in Akola (Berar). D. and W.'s Deccan list does not include this species.

Haliastur indus (Boddaert). The Brahminy Kite.

Falco indus Boddaert, Tabl. Pl. Enlum (1783), p. 25 for pl. Enl. 416—Pondicherry.

No specimens collected.

Noted at: Borgampād, Manānūr (7 February, Mrs. Tasker !), Deglūr, Kaulās, Utnoor, Kannad.

A fairly common species. Curiously enough I failed to meet it on the Amrābād Plateau between 3 and 21 October, though Mrs. Tasker who visited the place subsequently, in February, found it there. The Brahminy Kite

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moves about locally a good deal with the seasons, a fact well known to residents in Bombay and suburbs. In the Punjab also, Mr. Whistler has found it to be an almost entirely rains visitor.

Breeding: Col. Sparrow has 3 clutches of 2 eggs each taken at Mirzāpalli and Masāipet between 25 January and 19 February.

Davidson and Wenden (S.F., vii, 75) record it as rather rare in the Deccan. They shot a female on January 16 from a newly-built nest—no eggs—on the Bhima river which would have laid in about a week. Another nest on the Bhima River on 24 April contained 1 egg and 1 chick, and a third on 14 February on the Dew River (14 miles from Poona) one nestling. According to Vidal (N. & E., iii, 171) it breeds in South Konkan from the middle of January to the end of March. I found this to be the case in the Kolaba Dist. (N. Konkan) also.

Milvus migrans govinda Sykes. The Common Pariah Kite.

Milvus govinda Sykes, P.Z.S. 1832 (31 July, 1832), p. 81—Dukhun.

No specimens collected.

Noted at: Hyderābād City and Environs, Manānūr, Borgampād, Nelipāka, Kandahār, Deglūr, Kaulās, Ūtnoor, Aurangābād, Kannad, Vijāpūr (1924).

An ubiquitous species in open country, especially in the neighbourhood of towns and villages. Large assemblages were sometimes seen on marshy ground bordering tanks etc. in the vicinity of Manānūr. Pariah Kites are invariably present in some numbers at wayside carcases in company with vultures, and about slaughter-houses, wherever they may be.

Breeding: The first pair observed in copula was on 7 November (Nelipāka), while as late as 14 April two nests were noted on large tamarind trees near the weekly bazaar square in Aurangābād with birds sitting on them, obviously brooding.

Col. Sparrow took seven clutches of two eggs each in varying stages of incubation at Trimulgherry, between 8 November and 6 March.

In the Bhīma Valley (Deccan) it breeds freely from the middle of September to the middle of March (Davidson and Wenden, S.F., vii, 75.)

Elanus cœruleus (Desfontaines). The Black-winged Kite.

Falco cœruleus Desfontaines, Hist. (Mem.) Acad. Paris 1787 (1789), p. 503, pl. 15—Algiers.

No specimens obtained.

Noted at: Kandahār and Deglūr only. Col. Sparrow has seen it at Alwal and Masāipet.

This little Kite was met with singly in open country about cultivation. Its flight consists of slow and deliberate wing-beats reminiscent of the Blue-Jay (*Coracias*).

Capt. J. H. Yule (N. & E., iii, 179) describes it as very common about Poona, where he took eggs in June, July, August, September and October and found a nest with young on 2 February.

In the Sholāpūr District, Davidson (N. & E., iii, 180) considered it the commonest bird of prey. He found many nests with young and also many fledged young in April, and again with eggs in the last week of June. Davidson and Wenden (S.F., vii, 75) record it as moderately common in the Bhīma Valley. They took C/3 on 10 July and state that it breeds abundantly in December in Caladgi District, some 50 miles from Sholāpūr.

Circus macrourus (S. G. Gmelin). The Pale Harrier.

Accipiter macrourus S. G. Gmel., Nov. Comm. Acad. Petrop., vol. xv (1771), p. 439, pl. viii, ix—Woronecz to River Don, Russia.

Specimen collected: 356 ♂ 23-11-31 Pāloncha 300 ft. Col. Sparrow obtained the following: ♀ 2-1-11, ♂ 14-2-11 Dichpalli; ♂ 21-2-11 Medchal.

Elsewhere noted at: Kaulās (20 March), Pārtūr (31-1-11, Col. Sparrow !).

Iris bright lemon yellow; bill horny-black; cere and gape yellowish-green; legs and feet bright yellow; claws black.

The Pale Harrier was usually seen skimming over standing fields of jowari and rice and low scrub jungle, perching now and again on clods, mounds and the like. The stomach of the specimen contained a field-mouse.

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Its testes were in a quiescent state.

I do not give other sight records owing to the uncertainty of the species to which they refer.

Circus pygargus Linnæus. Montague's Harrier.

Circus pygargus Linn., Syst. Nat., ed. x, vol. i (1758), p. 89—England.

Specimens collected: 363 ♀ 24-11-31 Pāloncha 300 ft.; 539 ♀ 12-3-32 Deglūr (both imm.) 1,300 ft. Col. Sparrow shot one at Wadiārum ♂ (juv.) 16-12-10.

Haunts and habits same as the foregoing.

Iris brown; cere lemon yellow, base of lower mandible and gape greenish grey, rest of bill horny black; mouth bluish-slate; legs and feet bright ochre yellow; claws black.

No. 539 (12 March) was very fat suggesting that it was preparing to emigrate. Its stomach contained a field-mouse and 1 large locust, apparently *Acridium peregrinum*. The ovaries of both were undeveloped.

Circus æruginosus (Linnæus). The Marsh Harrier.

Falco æruginosus Linn., Syst. Nat., ed. x, vol. i (1758), p. 91—Sweden.

No specimens obtained by the Survey. Col. Sparrow procured the following: ♂ 16-1-13 Medohil (Madhol ?); ♂ ad. 9-2-13 Kupra (?); ♂♀ 9-11-13 Chintakani Tank.

Noted at: Narsampēt, Pākhāl.

The Marsh Harrier was seen in the neighbourhood of tanks and marsh land, skimming on motionless wings close over the reed beds or water-logged fields, and dropping now and again on some unwary frog, lizard or snake.

Astur badius duss umieri (Temm.). The Shikra.

Falco dussumieri Temm., Planch. Color. d'Ois (1824), livr. 52, pl. 308—Bengal.

Specimens collected: 604 ♀ 24-3-32, 612 ♂ 26-3-32 Kaulās 1,350 ft.; 716 ♂ 18-4-32 Kannad 2,000 ft.

Elsewhere noted at: Hyderābād City and Environs, Manānūr, Farahābād, Kandahār, Ūtnoor, Aurangābād.

Iris bright orange, reddish-orange or orange-scarlet; cere yellow, rest of bill slaty-grey, blackish on culmen; legs and feet yellow; claws black.

The Shikra is a resident, commonly distributed and familiar little hawk throughout the State. It affects gardens, mango and tamarind groves and open deciduous forest, but preferably keeps to the neighbourhood of villages and cultivation. Its usual call notes are exactly like those of the Black Drongo only somewhat louder. Near villages they are very destructive to young chickens. The stomach of No. 604 contained a field mouse, apparently *Mus buduga*.

Breeding: No. 604 (24 March) had the ovaries enlarged, the largest follicle measuring 4 mm. in diameter. Judging from the oviduct, the bird had apparently not laid yet, but it was one of a pair who had a nest in a leafy mango tree in the grove where we were encamped. No. 612 (25 March) was observed carrying a twig in its feet into the leafy top of a large tamarind tree in the village precincts, where it was building. Its testes were in breeding condition, measuring 16×7 mm. No. 716 (18 April), evidently also breeding, had testes 14×6 mm. The birds were very noisy at this time, and pairs were frequently observed indulging in curious aerial antics. The note commonly uttered at this, the breeding season, was a sharp double *ti-tui*.

Col. Sparrow took many clutches of the Shikra's eggs, usually 1 to 3, at Bezwādā, Eswantarāopēt and elsewhere in the State, between 4 April and 2 June.

Davidson and Wenden (S.F., vii, 73) found this species common in the Bhīma Valley at all seasons. They took C/2 (fresh) on 31 March. In Akolā (Berār) it breeds in May and June (B. Aitken, N. & E., iii, 121).

Accipiter nisus (Linn.) subspecies? The Sparrow-Hawk.

Falco nisus Linnæus, Sys. Nat., ed. x, vol. i (1758), p. 92—Sweden.

Not met with by the Survey. Col. Sparrow has a sight record from Masāipet 3-12-13.

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Pernis ptilorhynchus ruficollis Lesson. The Indian Crested Honey-Buzzard.

Pernis ruficollis Lesson, Traité d'Orn. 1830, p. 77—Locality unknown = Bengal.

Specimen collected: 585 ♀ 21-3-32 Kaulās 1,350 ft.

Elsewhere noted at: Manānūr and Narsampēt.

Iris bright yellow; bill horny-black, greyer at base of lower mandible; legs and feet dirty yellow; claws horny-black.

[According to the Key to the species of Pernis (F.B.I., 2nd ed., vol. v, p. 165)—'black subterminal and median bands much narrower than the paler ones'—the specimen would fall under *Pernis apivorous*. As D'Abreu has pointed out, however (J.B.N.H.S., xxxv, 219), birds from the Central Provinces with the above characteristics are *P. p. ruficollis*. The Key therefore needs amending. The wing of the specimen measured 444 mm.]

The Crested Honey-Buzzard is not uncommon in the well-wooded tracts of the State, where it was frequently observed soaring in circles high above the forest, usually singly but sometimes in pairs. In flight the rounded tail, cross-barred black and white, and the similarly but more closely barred under-surface of the wings is conspicuous. The call uttered in flight is a high-pitched, short scream-like whistle, quickly repeated. It has also a single prolonged note *whee-ee-eew* which I have only heard when the bird is perched on some tree-top.

A large quantity of honey dripped from the bill of the specimen when held up by its legs, and its stomach contained a greenish honey-scented mass. Its ovaries gave no positive indication as regards breeding, though the follicles were distinctly granular and appeared to be enlarging.

Breeding: Col. Sparrow has taken the following eggs: C/1 5-4-13, C/1 6-6-14 (both fresh). Eswantarāopēt; C/2 (hard set) 8-6-14 Kāmāreddi.

Davidson and Wenden (S.F., vii, 75) found this species rather rare about Sholāpūr. They saw a pair breeding on 6 February and state that the birds were very noisy.

Order: Columbæ.

Family: Columbidæ.

Crocopus phœnicopterus chlorigaster (Blyth). The Southern Green Pigeon. (Telūgū: *Pacha-polka*).

Vinago chlorigaster Blyth, J.A.S.B., vol. xii (1843), p. 167, note—no locality = South India.

Specimens collected: 74 ♂ 9-10-31 Manānūr 2,000 ft.; 320 ♀ 15-11-31 Nelipāka 160 ft.

Elsewhere noted at: Farāhābād, Borgampād, Pāloncha, Narsampēt, Pākhāl Lake, Kaulās, Utnoor.

Iris outer ring pink, inner bright lapis blue; bill pale French grey, basal portion including cere greenish; mouth greyish-pink (greyish-yellow in 320); legs and feet bright chrome yellow; claws French grey.

Common throughout the forested tracts of the State and also found sparingly in the opener portions where they come long distances to gorge themselves on the ripe figs of *Ficus bengalensis*, *F. religiosa*, *F. glomerata* and others. They are likewise partial to ripe Ber (*Zizyphus oenoplia*) and *Bridelia Hamiltoniana* berries. I found this Green Pigeon most abundant in the deciduous forest round Narsampēt, the total prohibition of shooting and snaring in this area, which is H. E. H. the Nizam's *Shikārgāh*, doubtless being mainly responsible for their abundance. Flocks of 30 to 50 birds were common in this locality, while often they were much larger.

The birds have a remarkable capacity for studiedly obliterating themselves among the foliage of a tree as if they were conscious of the camouflage afforded them by their plumage. When a tree is approached, the birds promptly get out of the skyline, become silent and motionless having got behind the foliage in such a cunning manner that while the body may be fully exposed, looking for all the world like a leaf among the leaves, the concealed head will be watching the movements of the intruder through some tiny opening between

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the leaves! It is only with the help of powerful field glasses that these manoeuvres can be followed.

The gonads of the specimens were in an undeveloped condition.

Davidson and Wenden (S.F., vii, 86) write: 'Observed but rarely about Sholāpūr. Commonest at Lanoli and Egutpoora. Nests taken on the Satāra Hills where it is not uncommon, in March. Observed at Nulwar'.

Muscadivora ænea sylvatica (Tickell). The Imperial Green Pigeon.

Columba sylvatica Tickell, J.A.S.B., vol. ii (November 1833), p. 581—Borabhum.

Specimen collected: 162 ♂ 18-10-31 Farāhābād 2,800 ft.

Elsewhere noted at: Nelipāka and Pāloncha. Also at Kamlāpūr near Sironcha (Col. Sparrow 6-6-12 !).

Iris crimson; eyelids magenta; bill horny-grey, magenta at base of upper mandible and on culmen; mouth pinkish-grey; legs and feet magenta; claws dusky-horn.

The Imperial Green Pigeon is confined to forests, in my experience only in the eastern and southern portions of the State. Numbers collect to feed on the various Fici and other trees when in fruit, but ordinarily they are mostly met with singly or in pairs. Occasionally small parties of three or four birds are seen.

The crop and stomach of the specimen contained figs of *Ficus glomerata*, *F. bengalensis* and *F. religiosa* exclusively. The gape and gullet in this species is remarkably capacious and elastic. When opened out to the full they were large enough, in the specimen, to accommodate a sour lime 1½ in. in diameter without difficulty.

The testes of the specimen were in non-breeding condition.

Chalcophaps indica (Linnæus). The Bronze-winged or Emerald Dove.

Columba indica Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 164—India.

No specimens obtained.

Only once seen at Pāloncha (19 November) as a solitary bird in thick scrub undergrowth in deciduous forest.

Columba livia intermedia Strickland. The Blue Rock Pigeon.

Columba intermedia Strickland, Ann. Mag. Nat. Hist., vol. xiii (January 1844), p. 39—India.

Specimen collected: 412 ♂ 2-12-31 Narsampēt 800 ft.

Elsewhere noted at: Amrābād Plateau, Kandahār, Kaulās, Ellora Caves, Daulatābād Fort. Also Hyderābād City and Environs and other towns in the Dominions, here probably a mixed breed.

Iris orange; bill brownish-black, cere powdery greyish-white; legs and feet magenta; claws brownish-black.

These pigeons were met with in flocks of 10-15 birds, usually on or about rock scarps, ruined forts etc. where they nested in holes and on ledges.

Breeding: The specimen (2 December) had well-developed elongate testes 22 mm. long. It was one of a pair nesting in a hollow in the decaying trunk of a *Borassus* palm in scrub country, at a height of about 20 ft. The bird was clinging to the outside of the hollow somewhat like a woodpecker.

Columba elphinstonii (Sykes). The Nilgiri Wood-Pigeon.

Ptilinopus elphinstonii Sykes, P.Z.S. 1832 (November), p. 149—Nilgiris.

No specimens obtained.

I got just a glimpse of a pigeon in the forest round Manānūr (at the foot of the Mahēswara Plateau) which may have been this species.

According to the *Fauna* (2nd. ed., vol. v, p. 229) Col. Sykes obtained this pigeon in the 'Deccan Ghats', where it was rare. The exact locality is unspecified.

Streptopelia orientalis (Latham). The Rufous Turtle-Dove.

Columba orientalis Latham, Index. Orn., vol. ii (1790), p. 606—China.

No specimens obtained.

A single bird was seen in dense hill forest at Kaulās (23 March). It has a deep guttural *Coo*.

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Davidson and Wenden (S.F., vii, 86) found this dove common in Satāra and neighbouring hills.

Streptopelia chinensis suratensis (Gmelin). The Indian Spotted Dove. (Telūgū for all doves: *Gooā*).

Columba suratensis Gmelin, Syst. Nat., vol. i, pt. ii (1789), p. 778—Surat.

Specimen collected: 169 ♂ 18-10-31 Farāhābād 2,800 ft.

Elsewhere noted at: Hyderābād City and Environs, Manānūr, Borgampād, Nelipāka, Pāloncha, Pākhāl Lake, Āsifābād, Kandahār, Kaulās, Utnoor, Kannad, Bhāmarvādi.

Iris pale reddish-brown; eyelids dull crimson; legs and feet bright magenta; claws brown.

The Spotted Dove is generally distributed throughout the Dominions, inhabiting both open country (with or without cultivation) and deciduous forest. The density of its numbers, however, varies considerably in different localities. At Pāloncha for instance it was noted as the commonest dove both inside and out of forest, while on the other hand it was comparatively rare at Kandahār, Aurangābād and Kannad where its numbers were conspicuously lesser than any of the other three species, namely *Streptopelia risorius*, *S. cambayensis* and *Œnopopelia tranquebarica*. On the whole I found it much less common in the opener and drier districts of the Mahrattwāda than in the forested portions of the Telingāna.

Breeding: The testes of the specimen (18 October) were in non-breeding condition. On 25 September, however, a nest was located in a garden at Saifābād (Hyderābād City)—the usual flimsy platform of twigs—about 8 ft. up in a Nīm tree containing two eggs which the parent was brooding.

On 4 April (Utnoor) a partially fledged young, just out of nest, was observed.

Col. Sparrow has taken eggs at Trimulgherry between 31 October and 9 May. It is common in Sholāpūr during the rains (D. & W., S.F., vii, 86).

Streptopelia senegalensis cambayensis (Gmelin). The Little Brown Dove.

Columba cambayensis Gmelin, Syst. Nat., vol. i, pt. ii (1789), p. 779—Cambaya.

Specimen collected: 482 ♀ 18-12-31 Āsifābād 1,200 ft.

Elsewhere noted at: Hyderābād City and Environs, Jedcherla, Achampēt, Nāgar Karnūl, Manānūr, Borgampād, Pāloncha, Āsifābād, Kandahār, Kaulās, Nīrmal, Aurangābād, Kannad, Bhāmarvādi.

Iris brown; eyelids pale magenta; bill brownish-black; legs and feet magenta; claws like bill.

The Little Brown Dove is an inhabitant of open country and cultivation and eschews forest. Thus it was absent at Farāhābād and Utnoor, while at Āsifābād and elsewhere, although met with in open country and cultivation on the *fringe* of forest, it was never actually within. It loves the boulder hillock country such as obtains in the environs of Hyderābād City and Hanamkōnda and was also noted as very partial to the thick patches of *Opuntia* scrub on the outskirts of Aurangābād town.

Breeding: The ovaries of the specimen were in non-breeding condition. The following records of nests were obtained:

(1) 15 March (Deglūr). On rafter in verandah of inhabited bungalow, 9 ft. up. Bird brooding.
(2) 22 March (Kaulās). In bush at 18 in. from ground, scrub jungle. 2 eggs measuring 26×18 and 24×18 mm.
(3) 25 March (Kaulās). In fork of low tree at about 3 ft., open deciduous forest. 2 eggs.
(4) 25 March (Kaulās). In bush at about 2 ft., open deciduous forest. 2 eggs.
(5) 27 March (Kaulās). In niche in wall of ruined fort, a few feet distant from nest of Scavenger Vulture. 2 eggs.
(6) 29 March (Nīrmal). In bush in borrow-pit by motor road at 4 ft. 2 eggs.
(7) 12 April (Nīrmal). On stone ledge in ruined fort wall at 5 ft. 2 eggs.

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... (S) 16 April (Kannad). In Karonda bush bordering dry nullah at 5 ft.; open scrub and cultivated country. No eggs yet.

The injury feigning habit when its nest is approached suddenly and without warning, is a common feature with this bird.

Col. Sparrow has taken eggs of this species at Trimulgherry between 12 April and 28 August. It is common throughout the Sholāpūr District, and breeds (D. & W., S.F., vii, 86). B. Aitken found a nest on the ground in Berar in November (N. & E., ii, 353).

Streptopelia risorius (Linnæus). The Indian Ring Dove.

Columba risoria Linnæus, Syst. Nat., vol. i (1766), p. 285—India.

No specimens obtained.

Noted at: Jedcherla, Achampēt, Nāgar Karnūl, Manānūr, Borgampād, Pāloncha, Āsifābād, Kandahār, Kaulās, Utnoor, Aurangābād, Kannad, Bhāmarvādi.

The Ring Dove is another common member of this group which has a general distribution in Hyderābād. I, however, failed to meet it at Farāhābād and noted that in wooded country as at Utnoor, Āsifābād and elsewhere it was markedly less abundant than the Spotted Dove.

It is a bird primarily of open cultivated country interspersed with patches of Babool or *Butea*, into the foliage of which it can retire in the hotter parts of the day, emerging again to feed at about three in the afternoon. In the neighbourhood of Borgampād it has been recorded as the most numerous of the doves.

Breeding: Col. Sparrow has taken eggs at various places in the Deccan in all months between 11 January and 26 August except June and July.

Œnopopelia tranquebarica (Herman). The Indian Red Turtle-Dove.

Columba tranquebarica Herman, Observ. Zool. (1804), p. 200—Tranquebar.

No specimens obtained.

Noted at: Hyderābād City and Environs, Borgampād, Kandahār, Nīrmal (1925).

This species appears to be rather patchily distributed in our area. With the exception of Borgampād, and perhaps Kandahār, it was nowhere common, its numbers even at these places being far less than any of the other doves. It is usually seen singly or in pairs feeding in the mornings and afternoons in company with other doves in freshly-sown jowari fields etc. It retires into shady trees during the heat of the day.

Breeding: Col. Sparrow has records of eggs from various places in the Deccan for January, February, March and November.

Order: Pterocletes.

Family: Pteroclidæ.

Pterocles indicus (Gmelin). The Painted Sandgrouse.

Tetrao indicus Gmelin, Syst. Nat., vol. i, pt. ii (1789), p. 755—Coromandel Coast.

Specimens collected: 275 ♀, 276 ♂ 9-11-31 Nelipāka 160 ft.; 598 ♂ 23-3-32 Kaulās 1,400 ft.

Elsewhere noted at: Utnoor, Bhāmarvādi.

Iris brown; bill orange-brown; naked skin round eye pale yellowish-green; hind (unfeathered) portion of tarsus and feet dull yellow or greyish leaf-green; claws brownish-orange to dark brown.

Met with in small numbers in parties of 5 or 6 birds, but more often pairs, on open stony patches in the midst of thick deciduous or scrub jungle. The birds were not abundant anywhere, but in the country round Utnoor two or three pairs were frequently flushed in the course of a morning's collecting. Pairs were usually observed coming down to drink at a rocky pool in a nullah-bed as late as 6-50 p.m. when dusk had well set in. This seems to be a regular habit as it was also noted at Kaulās on several occasions. The stomachs and crops of Nos. 275 and 276 contained grass seeds and some small berries.

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Breeding: The organs of Nos. 275 and 276 (9 November) shot from a small flock of 5 or 6 birds, were undeveloped, but the testes of 598 (23 March), one of a pair, appeared to be enlarging. They measured 5×3 mm. From now onwards also, the birds were seen almost invariably in pairs.

Col. Sparrow found nests and eggs in thin jungle about Eswantaraopēt as follows: 1 in January, 1 in February, 2 in March, 3 in April and 3 in May.

Pterocles exustus erlangeri Neumann. The Common Indian Sandgrouse.

Pterocles exustus erlangeri Neumann, Orn. Monatsb. 1909, p. 154—Lahadj, S. Arabia.

Specimen collected: 459 ♀ 13-12-31 Āsifābād 1,200 ft.

Elsewhere noted at: Nelipāka, Pāloncha, Kandahār, Mūkhēr, Kaulās, Vijāpūr.

Iris dark brown; eyelids greenish yellow; bill horny-plumbeous; feet and claws greyish-brown.

The Common Sandgrouse was usually met with in small flocks of 4-15 birds on fallow-land, stubble country or newly ploughed fields. At Mūkhēr a great many of these parties were observed coming to drink in relays at a sandy stream, and at Deglūr at a tank, at about 8-30 in the mornings.

Breeding: The ovaries of the specimen gave no indication as regards breeding.

Col. Sparrow has taken 2 fresh eggs at Omri (?) Deccan on 8-2-11, and found 4 nests containing young, about a fortnight old, at the same place on 16-2-14.

Order: Gallinæ.

Family: Phasianidæ.

Pavo cristatus Linnæus. The Common Peafowl.

Pavo cristatus Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 156—India.

No specimens collected.

Noted and/or shot at: Manānūr, Farāhābād, Nelipāka, Āsifābād, Kaulās, Utnoor, Bhāmarvādi.

The Peafowl is common in all afforested tracts within the State and was usually met with in flocks of 6 or 7 birds. They were particularly abundant at Utnoor in the forest about Arti-Margoo, where they regularly trooped down to drink at pools in the rocky stream-bed between 7 and 9 in the mornings and again at about 5-30 p.m.

Breeding: On 16 October a flock containing besides adults, 3 or 4 young slightly larger than a fair-sized Orpington hen, were observed at Farāhābād. The condition of the gonads of 4 specimens shot on 5 April (Utnoor) was as follows: (1) testes enlarged to 24×12 mm. (2 & 3) ovarian follicles ca. 3 mm. in diameter (4) immature; ovaries undeveloped.

Col. Sparrow took a clutch of 4 hard-set eggs by the Indravati River (C.P.) on 23-5-12.

Gallus sonneratii Temminck. The Grey Jungle Fowl.

Gallus sonneratii Temm., Pig. & Gal., vol. ii (1813), p. 246—India.

Specimens not collected.

Noted and/or shot at: Manānūr, Farāhābād, **Nelipāka, Pāloncha, Narsampēt**, Āsifābād, Utnoor.

♂ Iris orange-brown; bill horny-brown, commissure and lower mandible paler (yellowish); legs and feet yellow; spurs horny-brown.

The Grey Jungle Fowl is common in the afforested portions of the State where it affects scrub jungle in the vicinity of cultivation. It is usually met with in small parties, but the cocks often detach themselves and keep singly. At Manānūr and Farāhābād their crowing was one of the commonest jungle sounds early in the mornings and at dusk, sometimes even continuing till almost pitch dark. It is generally uttered from the top of an ant-hill, stone or fallen log and is not invariably preceded by a flapping of wings. The birds roost at night up in a bamboo clump or in trees.

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Berries picked up from under the bushes, especially those of *Zizyphus œnoplia*, are eaten to a very large extent, and these birds are doubtless responsible to a considerable degree for the dissemination of the seed of this plant.

A cock shot on 6 October (Manānūr) was moulting primaries, secondaries and neck-hackles. Another, an immature bird, on 9 November was moulting primaries and secondaries.

Breeding: On 14 November (Nelipāka) several family parties consisting of parents and 3-5 young were observed. The young were about three-quarters grown and from analogy with domestic birds would be 2-3 months old.

Galloperdix spadicea (Gmelin). The Red Spur-Fowl.

Tetrao spadiceus Gmelin, Syst. Nat., vol. i, pt. ii (1789), p. 759—Madagascar *errore* = Nilgiris.

No specimens obtained.

Noted at Manānūr, Farāhābād and Utnoor in bamboo forest and on rocky deciduous hillsides with thorny scrub, usually in pairs.

Galloperdix lunulata (Valenciennes). The Painted Spur-Fowl.

Perdix lunulata Valenciennes in Levrault's Dict. Sci. Nat., vol. xxxviii (1826), p. 446—Bengal.

Specimens collected: 568 ♂ 18-3-32, 617 ♀ 26-3-32 Kaulās 1,350 ft.

Elsewhere not noted.

Iris hazel brown; bill horny-brown, paler at chin; legs and feet greyish olive-brown; claws and spurs horny-brown.

This beautiful Spur Fowl was not uncommon in the above locality. It was usually seen in pairs in rocky, broken scrub-country or on hillsides. It is a good runner and reluctant to leave the ground unless hard-pressed or fired at, when it arises for a few yards but settles down again to continue the run.

Breeding: No. 568 was in fresh plumage, but its testes were undeveloped. In 617 (26 March) the ovary was mature, the largest follicle measuring 13 mm. in diameter. From the distended condition of the oviduct, moreover, it was evident that she was laying.

Col. Sparrow found several nests with eggs—usually 3, occasionally 4—in varying stages of incubation, among the small rocky hillocks at Eswantarāopēt between March and August, mostly in May.

Coturnix coturnix coturnix (Linnæus). The Common or Grey Quail.

Tetrao coturnix Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 161—Sweden.

Specimens shot (not preserved): 22-11-31 Pāloncha 300 ft.; 20-3-32 Kaulās 1,350 ft.

I found the Grey Quail to be rare in Hyderābād State, the above being the only two occasions when it was come across—singly in *toour* fields.

Coturnix coromandelicus (Gmelin). The Black-breasted or Rain Quail.

Tetrao coromandelicus Gmelin, Syst. Nat., vol. i, pt. ii (1789), p. 764—Coromandel.

Specimens collected: 519 ♀ 7-3-32 Mūkhēr 1,400 ft.; 540 ♂ 13-3-32 Deglūr 1,350 ft.

Elsewhere noted and/or shot at: Kandahār, Kaulās, Utnoor.

Iris orange-brown; bill horny-grey, dusky on culmen; legs, feet and claws pale yellowish flesh-colour.

Though met with rather more frequently than the preceding, this species was also nowhere really common or abundant. It was usually found in pairs, less often coveys of 6-8 birds, in grassland, gram-fields or in and about cut jowari fields.

The specimens were in fresh plumage, but their organs were in a quiescent condition.

Perdicula asiatica (Latham). The Jungle Bush Quail.

Perdix asiatica Latham, Index Orn., vol. ii (1790), p. 649—Mahratta region.

Specimens collected: 310 ♂ 14-11-31 Nelipāka 160 ft.; 386 ♂ 30-11-31 Nrasampēt 800 ft.; 541 ♀ 13-3-32 Deglūr 1,400 ft.; 654 ♂ 5-4-32, 658 ♂ 6-4-32 Utnoor 1,250 ft.

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Elsewhere noted at: Borgampād, Pāloncha, Kandahār, Kaulās, Aurangābād. Iris pale brown to orange-brown; bill blackish-brown on upper mandible, grey on lower mandible and at base of commissure; mouth greyish-pink; legs and feet dusky orange-yellow; claws flesh colour.

Whether the Jungle and Rock Bush Quails are really two different species or races, or whether they are merely dimorphic forms of the same species is a question that still remains to be settled. I am uncertain about their respective distributions in Hyderābād and also cannot be sure if I ever saw the two forms associating in one and the same covey as has recently been suggested. The professional snarers recognise two forms or 'species', examples of which I was shown. What is known to them as *Lowwa* I found was *P. asiatica*, whereas *Girja* was *P. argoondah*. I was told that round Manānūr both forms occurred in the same terrain which necessitated the employing of both species of decoys or call-birds.

Bush Quails (along with partridges, bustard and hares) are largely netted in the Hyderābād State by Pārdīs and other professional snarers, often with complete disregard as to season, with the result that many areas have been more or less completely denuded of such game while in others the process of decimation is in full swing. Unfortunately even officials and vakils, and people who should know better, aid and abet in this work of destruction either directly by commissioning the snarers to snare for them for special occasions, or indirectly by purchasing birds brought to the bazaars for sale out of season. I once came across a party of snarers on the outskirts of Aurangābād town in the second half of April, and learnt that they had been commissioned to snare Bush Quails for a military 'bara saheb' in the British Cantonments who was giving a dinner party the next day!

In the list of close seasons given at the end of the Hyderābād Game Regulations—for the infringement of which there is a penalty prescribed—I find no reference to Quails at all. Surely this does not mean that quails may be shot or netted all the year round? It is an oversight that demands speedy rectification if it is desired that quails should not completely disappear from the State. However, even with statutory protection, unless there is at the same time a ruthless enforcement of the game laws it is unlikely that much can be achieved.

Breeding: On 10 October (Manānūr) I found a nest at the base of a small plant in a grassy patch in scrub jungle. It was a shallow depression lined with grass and contained 6 pure white eggs. The owner could not be secured so it is doubtful to which form it belonged.

The testes of No. 310 (14 November) were enlarged to 11×7 mm. and it was one of a pair, while those of No. 386 (30 November), also one of a pair, were sufficiently developed to suggest breeding. In the rest of the specimens the gonads were in a quiescent state.

The wing and tail quills of No. 654 had the curious appearance of being clipped!

At Trimulgherry, Col. Sparrow took several clutches of up to 6 eggs between 24 August and 26 March.

P. asiatica is common in the hills of Satāra and Nulwar according to Davidson and Wenden (S.F., vii, 87).

In Salsette I have seen chicks in down on 19 April (1925, Trombay Hill) and Mr. Prater obtained a similar chick in December at Andheri (1923).

Perdicula argoondah (Sykes). The Rock Bush-Quail.

Coturnix argoondah Sykes, P.Z.S. 1832 (22 November), p. 153—Dukhun.

No specimens obtained by the Survey, but the following in Col. H. R. Baker's Collection, all from Aurangābād, have been examined by Mr. Whistler and found to belong to this form: ♀ 14-3-07, ♂ 21-3-07, ♂ 9-6-07, ♀ 29-8-09, (♂) 9-9-09.

According to Davidson and Wenden (S.F., vii, 87) *P. argoondah* is very common and breeds in the Bhīma Valley, Deccan. At Oomraotee in Berār also, J. Aitken found it very common and breeding in November and December, while at Sholāpūr Davidson says it does so in the latter part of the rains (N. & E., iii, 441-442).

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Francolinus pictus (Jardine and Selby). The Southern Painted Partridge.

Perdix picta Jardine and Selby, Illust. Orn., pl. 50 (1828)—Bangalore.

Specimen collected: 581 ♂ 19-3-32 Kaulās 1,300 ft.; Col. Baker's Coll. contains ♂ 16-9-09 Aurangābād.

Elsewhere noted and/ or shot at: Hyderābād City Environs, Manānūr, Farāhābād, Narsampēt, Āsifābād, Kandahār, Mūkhēr, Utnoor, Itchora, Kannad.

Iris orange-brown; bill horny-black; legs and feet brownish-orange; claws horny-brown.

Widely distributed, in small numbers, all over the State but confined to well-watered patches where it keeps to the vicinity of streamlets, water channels and grassy water-logged ground. In the rains they move about a great deal locally, so that they may then be met with in places where there are none in the drier months.

The males have a habit of mounting stones or fallen logwood etc., bunds separating fields or isolated trees standing amidst them, and uttering their familiar far-reaching and often curiously ventriloquistic call; *Chick . . . cheek, cheek, keraykek* (or as the Emperor Bāber syllabified it; *Shīr dārem shakarek* !) mostly in the mornings up to 11 and then from 3 onwards right up to dusk. During the hottest parts of the day they are mostly silent.

Breeding: The testes of the specimen were in non-breeding condition.

Col. Sparrow found nests with 3 and 5 eggs respectively on 1 and 30 August (1912) at Trimulgherry, and 2 nests with 5 fresh eggs each at Bezwāda on 6-3-12.

Davidson and Wenden (S.F., vii, 87) describe the Painted Partridge as common in the Deccan (Bhīma Valley) and breeding in September. At Oomraotee in Berār it breeds in the Monsoon, most eggs being found in August and September (J. Aitken, N. & E., iii, 430).

The statement on p. 409, vol. v of the F.B.I., Birds (2nd edition), that Col. Sparrow found *Francolinus f. asiæ* common near Trimulgherry is most certainly erroneous. As far as I am aware no material is available to support the assertion that this species occurs as far south as Hyderābād. The Survey definitely failed to meet with it in the State.

Francolinus pondicerianus pondicerianus (Gmelin). The Grey Partridge.

Tetrao pondicerianus Gmelin, Syst. Nat., vol. i, pt. ii (1789), p. 760—Pondicherry.

Specimens collected: 703 ♀ 17-4-32 716 ♂ 18-4-32 Kannad 2,000 ft.; the Baker Coll. has: ♂ 17-2-07, ♀ 20-2-07 Aurangābād.

Elsewhere noted and/ or shot at: Hyderābād City Environs, Manānūr, Borgampād, Pāloncha, Narsampēt, Āsifābād, Kandahār, Mūkhēr, Kaulās.

Iris brown; bill horny-brown, paler at gape and base of lower mandible; legs and feet dusky coral red; claws brown.

[All the above specimens are clearly intermediate between *pondicerianus* and *interpositus*, but on the whole closer to the former.—H. W.]

The Grey Partridge is a common bird in Hyderābād State though owing to ceaseless and indiscriminate persecution, its numbers during recent years have been steadily on the decline in a great many areas. It frequents scrub jungle in the neighbourhood of fields. At Borgampād and Nelipāka a favourite haunt was the dense growth of *Vitex negundo* and other bushes bordering the Godāvari River whence they emerged into the adjacent jowari fields to feed.

I noted this species as absent at Utnoor between 1 and 10 April.

Breeding: A bird shot on 24 March (Kaulās) was half grown (apparently 1 or 2 months old) just undergoing complete moult into adult plumage. It was one of a brood of 4 in the company of parents. On 17 April (Kannad) a pair were noted accompanied by two young somewhat smaller than the above, while another pair, the next day, also had in attendance a couple of chicks of approximately the same age. In No. 703 (17 April—parent of the young recorded) the ovaries were reverting to non-breeding condition whereas No. 716 (18 April) accompanying the 3rd brood, still had enlarged testes measuring 13×8 mm.

The breeding season is apparently far from well-defined. The statutory close season, 1 March to 30 September, which unfortunately is nowhere very strictly observed, perhaps meets the requirements in a general way, but under

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a properly organised scheme of game protection it might in addition prove advisable to prohibit *netting and snaring* altogether and at all seasons in different areas by rotation until such time as they become sufficiently re-stocked.

A highly placed Hyderābād Police Officer, who was also a keen sportsman and Nature-lover, expressed his views as follows: 'The man with the gun does not do half so much damage as the snarer. The latter is like a broom for he sweeps everything before him into his net, old and young, male and female'. According to him a further factor in the depletion was the taking of eggs of ground game by herd-boys and the like. This of course should be made penal.

According to Davidson and Wenden (S.F., vii, 87) the Grey Partridge breeds in the Bhīma Valley in March and again during the rains. In Berār J. Aitken (N. & E., iii, 436) found it breeding in the beginning of the year. He took C/6 in February.

Order: Hemipodii.

Family: Turnicidæ.

Turnix suscitator taigoor (Sykes). The Common Bustard Quail.

Hemipodius taigoor Sykes, P.Z.S. 1832 (November), p. 165—Dukhun.

Specimens collected: 299 ♂ 12-11-31 Nelipāka 160 ft.; 616 ♂ 26-3-32, 619 ♀ 27-3-32 Kaulās 1,350 ft.

Elsewhere noted and/ or shot at: Manānūr, Pāloncha, Hanamkōnda.

Iris creamy white or China white; bill bluish-grey, blackish on culmen; legs and feet pale grey or greyish-white; claws dusky.

The Bustard Quail is widely distributed in Hyderābād but is nowhere abundant, being met with in pairs, rarely 3 or 4 together. It frequents scrub jungle and is partial to foot-paths or firelines, flanked with short grass and scrub, into which it comes out to feed.

Either the male or the female (probably the latter—but of this I am not positive) produces a loud drumming sound *Dr-r-r-r-r-r-r* and so on, which I have sometimes heard continued for over 15 seconds at a stretch. I have also heard this up to 10 o'clock on a pitch dark night. It is apparently a signal to other birds denoting the whereabouts of the producer, as frequently when a pair is disturbed and the birds fly off in different directions, one of them presently begins to drum.

Breeding: Only in No. 616 (26 March) did the gonads show any tendency towards development. Its testes measured ca 5×3 mm. and from the fact that the specimen was in perfect fresh plumage it is likely that it was preparing to breed.

On 12 October (1928—Hanamkōnda) I found a nest containing 3 fresh eggs off which the parent bird (male) was shot. There was no depression or lining; the eggs lay on the bare ground with a few blades of the short growing grass bent over to form a rough flimsy bower. The eggs were greyish-buff in colour with reddish-brown spots and speckles. The nest was situated in a patch of scraggy grass in light scrub jungle.

At Kihim (Kolāba Dist.—North Konkan) I shot a female on 25 July which had a hard-shelled egg in its oviduct ready for laying.

Davidson and Wenden (S.F., vii, p. 87) found the Bustard Quail scattered sparingly all over the Sholāpūr District, and breeding there.

Order: Grallæ.

Family: Rallidæ.

Porzana pusilla pusilla (Pallas). The Eastern Baillon's Crake.

Rallus pusillus Pallas, Reise Russ. Reichs., vol. iii (1776), p. 700—Dauria.

Specimen collected: 392 ♀ (imm.) 30-11-31 Narsampēt 800 ft.

Elsewhere not noted.

Iris bright orange; bill leaf-green, brownish on culmen; legs and feet greyish-green; claws dusky.

The specimen—a solitary bird—was flushed in a thick swampy reed-bed at the edge of a tank, where it lay very low.

Its skull had an unossified patch in the centre.

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Amaurornis phoenicurus (Pennant). The Chinese White-breasted Water-hen.

Gallinula phœnicurus Pennant, Ind. Zool. (1769), p. 10, pl. ix—Ceylon.

Specimen collected: 192 ♂ 29-10-31 Borgampād 160 ft.

Elsewhere noted at: Narsampēt, Kaulās.

Iris damaged; bill sage-green, reddish on forehead and at base of culmen; legs and feet brownish sage-green; claws brown.

Met with among bushes and undergrowth in the neighbourhood of village tanks, streamlets or water channels, singly or in pairs. Though an extremely noisy bird in the breeding season, it was now silent.

The testes of the specimen were undeveloped and it was undergoing heavy general moult.

According to Davidson and Wenden (S.F., vii, 90) the White-breasted Waterhen is tolerably common in the Bhīma Valley, Deccan. They found 5 nests at Nulwar in July.

Gallinula chloropus (Linnæus). The Indian Moorhen.

Fulica chloropus Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 152—England.

No specimens collected.

Noted at: Narsampēt, Kandahār, Utnoor, Dornakal.

Fairly common on lotus-covered tanks where they run about on the floating leaves in search of insects and water bugs. They are also good swimmers. The birds were particularly numerous at Utnoor.

Porphyrio poliocephalus (Latham). The Indian Purple Moorhen.

Gallinula poliocephala Latham, Suppl. Index. Orn. (1801), p. 68—India.

No specimens collected.

Noted at Narsampēt and Utnoor where the birds were not uncommon on lotus and reed-covered tanks.

Breeding: Col. Sparrow found 3 nests at Navipēt on 26-8-14 with 8, 5 and 4 eggs respectively, and one at Madaram on 30-11-13 with 2 eggs.

Fulica atra Linnæus. The Coot.

Fulica atra Linn., ed. x, vol. i (1758), p. 152—Sweden.

No specimens collected.

Several birds were observed on tanks at Narsampēt, Kandahār and Deglūr. Last seen on 14 March (1932).

Breeding: On 11-8-14 Col. Sparrow found 3 nests and on 14-8-14 1 nest at Navipēt containing 10, 8, 2 and 7 eggs respectively, while 2 nests at Eswantarāopēt on 29-8-14 held 8 and 4 eggs each.

Family: Jacanidæ.

Metopidius indicus (Latham). The Bronze-winged Jacana.

Parra indica Latham, Index. Orn., vol. ii (1790), p. 775—India.

No specimens collected.

Noted at: Nelipāka, Narsampēt, Utnoor.

The Bronze-winged Jacana was invariably present on lotus-covered tanks in the above localities, tripping gingerly over the large floating leaves.

Curiously enough the breeding biology of this common bird is almost unknown. Field work is necessary to determine, for instance, the significance of the fact that females are so much bigger than males, a condition different to that obtaining in the generality of birds of the same and allied families.

Hydrophasianus chirurgus (Scopoli). The Pheasant-tailed Jacana.

Tringa chirurgus Scopoli, Del. Flor. et Faun. Insubr., vol. ii (1786), p. 92—New Guinea *errore*=Philippines.

No specimens collected.

Noted at: Kāzipēt, Dornakal, Borgampād, Narsampēt and Utnoor.

A fairly common species being, like the above, present on every lotus-covered tank. The long and slender toes are most beautifully adapted for progression over floating vegetation. The weight of the bird is so well distributed by their means that not a ripple shows as it skips lightly from one leaf to another. At the season under reference they kept in flocks.

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Breeding: Col. Sparrow found nests at Bāsar on 10 and 11 August 1914, containing 3, 4 and 2 eggs respectively.

SUB-ORDER: ROSTRATULÆ.

FAMILY: ROSTRATULIDÆ.

Rostratula benghalensis benghalensis (Linn.). The Painted Snipe.

Rallus benghalensis Linn., Syst. Nat., ed. x, vol. i (1758), p. 153—Asia.

Specimen collected: 432 ♀ 7-12-31 Pākhāl Lake 800 ft.

Elsewhere noted at: Utnoor.

Iris dark brown; bill pale horny-brown; legs and feet greenish-grey; claws dark brown.

The Painted Snipe is, in my experience, not a common species in Hyderābād. The specimen was one of the only pair seen on marshy savannah land close to the lake, while at Utnoor also it was met with in very small numbers among reedy marshes bordering tanks.

The ovaries of the specimen were in a quiescent state.

Davidson and Wenden (S.F., vii, 89) describe this species as common at all seasons in the Deccan (Bhīma Valley) and believe that it breeds there.

SUB-ORDER: GRUES.

FAMILY: GRUIDÆ.

Anthropoides virgo (Linnæus). The Demoiselle Crane.

Ardea virgo Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 141—'In Oriente'.

Not met with by the Survey.

These Cranes visit many parts of the State in large flocks during the cold weather to feed on ripening gram and wheat crops to which they cause a certain amount of damage.

Personally I have only come across and shot them at Vijāpūr in the Aurangābād District (1925).

They also visit the Bhīma Valley in the cold weather in immense flocks (D. and W., S.F., vii, 88).

SUB-ORDER: OTIDES.

FAMILY: OTIDIDÆ.

Choriotis nigriceps (Vigors). The Great Indian Bustard.

Otis nigriceps Vigors, P.Z.S. 1830-31 (March 2, 1831), p. 35—Himalayas.

Not met with by the Survey.

This magnificent bird, known in Hyderābād as Toqdār or Tughdār is found to my knowledge in the Aurangābād, Parbhani and Nānder Districts. I shot two males in fresh adult plumage on 20 October (1924), at Vijāpūr (Aurangābād District). The birds frequented open scanty grass country or waste land interspersed with scrub and bushes, in the neighbourhood of cultivation, and were then in widely separated pairs. They were extremely wary, but permitted a close approach in a bullock-cart. The wing expanse of one was 87½ inches.

They are said to be fairly numerous still in remoter areas, but almost shot out in some of their former haunts now made easily accessible by means of cars and motor buses.

Davidson and Wenden (S.F., vii, 87) write: 'Common and breeds. It is very much more common during the rains and cold season than at other times'. This relates principally to the Bhīma Valley—Deccan.

ORDER: CHARADRIIFORMES.

SUB-ORDER: OTI-LIMICOLÆ.

FAMILY: ŒDICNEMIDÆ.

Burhinus œdicnemus (Linnæus). The Stone Plover.

Charadrius œdicnemus Linn., Syst. Nat., ed. x, vol. i (1758), p. 151—England.

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No specimens collected.

Noted at: Nelipāka, Utnoor.

The Stone Plover was met with on several occasions at Nelipāka frequenting heavy thorn-scrub country, either singly or in widely scattered pairs. Being of crepuscular habits, they usually came out at dusk to feed in open spaces in the scrub jungle, and small flocks of 5 or 6 were observed at such times.

At Utnoor, only a single pair was seen on broken, stony ground in sparse deciduous forest.

Esacus recurvirostris (Cuvier). The Great Stone Plover.

Œdicnemus recurvirostris Cuvier, Règne Anim., ed. ii, vol. i (1829), p. 500—India.

Specimen collected: 281 ♂ 9-11-31 Nelipāka 160 ft.

Elsewhere noted at: Borgampād.

Iris lemon yellow; sides of bill at base including gape and base of lower mandible bright chrome yellow, entire culmen and rest of bill black; legs and feet greenish-grey; claws black.

The Great Stone Plover was present in small numbers, either singly or in small parties of 3 or 4 on the Godāvari and Kinārsāni Rivers, where they kept to the mudspits and sandbanks. The carriage of the body in flight is peculiarly arched, while the round white patch on the primaries is then rendered conspicuous. The birds are good runners, and when wounded the specimen also swam with ease and swiftness, riding the water very like a duck.

Its testes were undeveloped. The stomach contained small crabs and other crustacea exclusively.

Col. Sparrow found nests with eggs—one or two—in various stages of freshness and incubation on the Godāvari River at Bezwāda between 12 and 14 February (1914), and large young on 22-3-14.

Sub-order: Laro-limicolæ.

Family: Glareolidæ.

Sub-family: Cursoriinæ.

Cursorius coromandelicus (Gmelin). The Indian Courser. (Telūgū: *Chītwa*).

Charadrius coromandelicus Gmelin, Syst. Nat., vol. i, pt. ii (1789), p. 692—Coromandel Coast.

Specimens collected: 259 ♀, 260 ♂ 6-11-31 Borgampād 160 ft.; 557 ♂ 15-3-32 Deglūr 1,400 ft.

Elsewhere noted at: Āsifābād, Mūkhēr, Kandahār, Kaulās, Kannad.

Iris dark brown: bill horny-brown; mouth greyish-pink; legs and feet dirty China-white; claws dark brown.

The Indian Courser is a fairly common bird in the State, about cultivation, especially where this lies in the midst of open scrub country. It was met with singly or in pairs or small flocks of 6-8 birds and was partial to freshly ploughed fields. Its habit of running a few yards, halting abruptly and raising itself high, and then again resuming the run for a few yards further, is distinctive.

The stomachs of the specimens contained grubs, beetles, grasshoppers and crickets.

Breeding: The testes of No. 557 (15 March) measured 7×5 mm. and appeared to be developing, and the bird was in freshly moulted plumage. The gonads of the other two specimens gave no indication as regards breeding.

The Indian Courser breeds abundantly about Sholāpūr in April, May, June, July and August, chiefly during May and June (Davidson and Wenden, N. & E., iii, 323-4).

Rhinoptilus bitorquatus Blyth. Jerdon's Courser.

Macrotarsius bitorquatus Blyth, J.A.S.B., vol. xvii (1), 1848, p. 254—Eastern Ghats.

Not met with by the Survey.

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I scoured the country for miles both at Borgampād and at Nelipāka, and investigated every likely patch in search of this elusive creature; my shikaris (urged by promises of reward) and myself, were constantly on the look-out for it all through my stay at these two camps, but without success. Borgampād and Bhadrāchalam (near where Blanford obtained his specimens) are on either bank of the Godāvari River and lie almost directly opposite each other. It is therefore either that the birds move about with the seasons and I was looking for them at the wrong time, or that they have disappeared from the face of the earth altogether! Inspite of special effort, the Eastern Ghats Survey also failed to come across this species in Cuddapah and Nellore (where Jerdon first discovered it) or indeed anywhere else in the areas worked by them. It would be interesting to know what the last authentic record of its being shot or seen is.

The Telūgū name given in the Fauna, namely '*Adava-wuttu-titti*' was as great a mystery to the local Telūgūs as the bird itself, and one would like to know how it was come about!

Sub-family: Glareolinæ.

Glareola lactea Temminck. The Small Indian Pratincole or Swallow-Plover.

Glareola lactea Temm., Man. d'Orn., 2nd ed., vol. ii (1820), p. 503—Bengal.

Specimens collected: 221 ♀, 222 ♀, 223 ♀ 2-11-31 Borgampād 160 ft. Elsewhere not noted.

Iris dark brown; bill black; gape orange-brown; mouth pink; legs, feet and claws black.

These little Plovers were common on the Godāvari and Kinārsāni Rivers in flocks of upto 30 or 40 birds, either feeding or resting on the sandbanks or flying up and down the rivers.

I frequently observed them hawking winged insects in the twilight, after sunset, over an open patch of waste-land on the banks of the Godāvari, in company with Palm Swifts, both close to the ground (30 or 40 ft.) and higher up in the air. The flight and movements of the birds in this quest were exactly like those of a pipistrelle bat, and they stopped short, and turned and twisted in the air with the same agility and complete mastery. Their flight and actions were indeed so similar that in the case of the higher flying individuals it needed special attention to distinguish them as birds!

The stomachs of the specimens contained crustaceans and hymenopterous insects.

Breeding: The ovaries in each case were in a quiescent state.

Col. Sparrow collected 10 clutches of 1-4 fresh eggs each (some doubtless incomplete), at Bezwāda between 21 and 22 March 1913.

Davidson and Wenden (S.F., vii, 88) found these birds common on the Bhīma River in the cold weather.

Family: Sternidæ.

Sterna aurantia Gray. The Indian River Tern.

Sterna aurantia Gray, Illust. Ind. Zool., vol. i, pl. 69, fig. 2 (1831)—India.

Specimens not collected.

A tern seen about the junction of the Godāvari and Kinārsāni Rivers at Borgampād, in company with the next, was presumably this species. Its numbers were considerably less than those of the Black-bellied Tern.

Breeding: Col. Sparrow took a clutch of 3 fresh eggs and another of 2, on 6-3-12 at Bezwāda (Madras Presidency), and 3 more clutches (fresh) at the same place on 22-3-13. In the Central Provinces he found 2 hard set eggs on 19-5-12 on the Indravati River and notes that by that time the majority of young had flown.

Sterna melanogaster Temminck. The Black-bellied Tern.

Sterna melanogaster Temm., Planch. Color., pl. 434 (1827)—Ceylon.

Specimens collected: 217 ♀, 218 ♀, 219 ♂ 2-11-31 Borgampād 160 ft. Elsewhere not noted.

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Iris dark brown; bill, mouth, legs and feet bright orange; claws black.

The Black-bellied Tern was common on the Godāvari and Kinarsāni Rivers, often in large flocks, resting on the sandbanks and islets or flying to and fro over the water. When one bird drops to the shot two or three others immediately follow suit and plunge down almost instinctively with him. This is a familiar trait with other terns as well. I suggest that the birds do so because they think their companion has darted down at some food. After a couple of circles overhead, and on discovering the real cause, the other birds gradually move off.

I have frequently watched these Terns skimming slowly over the surface of the water against wind, taking advantage of the resistance as described under the Swallow (*Hirundo rustica*).

Breeding: The gonads of the specimens were in an undeveloped condition, and they were in varying stages of complete moult.

Col. Sparrow has taken several clutches of 1-3 eggs (mostly 3) at Bezwāda between 26 February and 7 April. He found a brood of 3 young, about 7 days old, on the Indrāvati River (Central Provinces) on 18 May (1912).

Family: Rhynchopidæ.

Rhynchops albicollis Swains. The Indian Skimmer.

Rhynchops albicollis Swainson, Anim. in Menag. (1838), p. 360—India.

Not met with by the Survey.

The Skimmer probably occurs in the Hyderābād State on the larger rivers such as the Godāvari and Krishna.

Col. Sparrow found it breeding at Bezwāda in the Madras Presidency and on the Indrāvati River in the Central Provinces, and took eggs in varying stages of freshness and incubation between 6 April and 19 May, by which latter date the majority of young had flown. The earliest date on which he saw flying young was 21 March (1913—Bezwāda).

Sub-order: Limicolæ.

Family: Charadriinæ.

Sub-family: Charadriinæ.

Charadrius dubius jerdoni (Legge). The Little Ringed Plover.

Ægialitis jerdoni Legge, P.Z.S. 1880 (June 1st), p. 39—Ceylon.

Specimens collected: 545 ♀ 14-3-32 Deglūr 1,300 ft.

Elsewhere noted at: Borgampād, Malkāpūr (along Nālgonda Road), Mūkhēr, Kandahār.

Iris brown; eyelids bright yellow; bill horny-brown, yellow at base of lower mandible; legs and feet yellow; claws brown.

A fairly common species but usually met with in small numbers—pairs or small parties of 5-7, occasionally more—frequenting the edges of tanks and shingly stream beds.

In most of its haunts the Ring Plover presents a remarkable example of protective colouration, and inspite of the white underparts it is often quite impossible to pick out a bird from its surroundings even at such short range as 10 or 15 yards, until it moves.

I noticed curious behaviour in the case of one of these birds feeding on marshy ground. At every step where no insect or crustacean was disturbed, the bird put out one of its feet slightly forward and 'drummed' with the toes on the soft mud with a rapid vibratory motion. In almost every case I could see it darting at something immediately after. I went up to the spot and tried the same manoeuvre with a piece of stick and discovered that this tapping really had the effect of dislodging a number of insects, sand-hoppers and tiny crabs lurking in holes in the mud. I have been able to confirm this observation several times subsequently and it has also been independently confirmed by my brother Mr. Hamid Ali. This appears to be a regular habit with the species.

Mr. Whistler points out that the habit of stamping on mud has been noted with Gulls in England, and recently also in America (Auk, April 1934, p. 234).

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Breeding: The ovaries of the specimen were undeveloped. It was undergoing heavy body and tail moult, the remiges being fresh.

Col. Sparrow took clutches of 3 fresh eggs each at Bezwāda on 14 February (1914) and 20 March (1913). Another C/3 was on the point of hatching on 8 April (1913).

Pluvialis dominicus fulvus (Gmelin). The Golden Plover.

Charadrius fulvus Gmelin, Syst. Nat., vol. i, pt. ii (1789), p. 687—Tahiti.

Specimen collected: 183 ♂ 29-10-31 Borgampād 160 ft.

Elsewhere not noted.

Iris dark brown; bill greenish-black; legs and feet greenish-grey.

Several flocks of 15 to 20 birds were observed in or about ploughed and freshly-sown jowari or partially inundated fields, in the neighbourhood of the Godāvari River.

The testes of the specimen were undeveloped.

[This is probably the bird which Fairbank records as *Squatarola helvetica*, 'Dakhan: in flocks in the cold weather' (S.F., iv, 262)—H. W.].

Sub-family: Vanellinæ

Hoplopterus duvaucelii (Lesson). The Spur-winged Plover.

Charadrius duvaucelii Lesson in Levrault's Dict. Sci. Nat., xlii (1826), p. 38—Calcutta.

Specimen collected: 191 ♂ 30-10-31 Borgampād 160 ft.

Elsewhere not noted.

Iris dark brown; bill black; wing-spurs horny-black; legs and feet greenish slaty-black.

These birds were present in small numbers on the sandbanks of the Godāvari and Kinārsāni Rivers, especially about their junction. They kept in small parties of 3 or 4 individuals.

The testes of the specimen were in normal non-breeding condition.

Lobivanellus indicus (Boddaert.). The Red-wattled Lapwing.

Tringa indica Boddaert., Tabl. Pl. Enlum, p. 5 on Pl. Enl. 807 (1783)—Goa.

Specimens not collected.

Noted at: Hyderābād City Environs, Manānūr, Borgampād, Nelipāka, Narsampēt, Kāndahār, Kaulās, Utnoor, Aurangābād.

The Red-wattled Lapwing or 'Did-he-do-it' is a common and familiar bird throughout the State being invariably met with in pairs or parties of 3 or 4 in the vicinity of tanks, flooded fields or puddles in open waste-land or in forest clearings.

Breeding: On 14 April (Aurangābād) a nest was found among scabs of dry algae on the bed of a small square masonry tank among the ruins near 'Bibi-kā-Maqbera'. It was a shallow depression or 'scrape' without lining, and contained 3 fresh eggs.

Col. Sparrow collected many clutches of 2-4 eggs at Eswantarāopēt, Trimulgherry and Navipēt between 14 April and 15 August. According to Davidson and Wenden (S.F., vii, 88) this Lapwing breeds from March to August in the Bhīma Valley (Deccan).

In the neighbourhood of Bombay (Salsette and Kihim—N. Konkan) I have taken many nests between 29 March and 31 July.

Lobipluvia malabarica Boddaert. The Yellow-wattled Lapwing.

Charadrius malabaricus Boddaert., Tabl. Pl. Enl., p. 53 for Pl. Enl. 880 (1783)—Malabar.

Specimens collected: 483 ♂, 484 ♀ 18-12-32 Āsifābād 1,200 ft.

Elsewhere noted at: Manānūr, Borgampād, Nelipāka, Pāloncha, Kandahār, Deglūr, Kaulās, Utnoor.

Iris brown; wattles and skin round eye bright lemon-yellow; bill brownish-black; legs and feet bright lemon-yellow; claws brownish-black.

This Lapwing is also a fairly common species, being met with in pairs or small parties of 3 or 4 on fallow and waste-land or ploughed fields, less dependently on the neighbourhood of water than the foregoing.

Baker says (F.B.I., vol. vi, p. 191) that 'in flight, food and voice it is very similar to the Red-wattled Lapwing'. As regards the voice, at any rate,

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this statement is hardly correct. Its cry has no suggestion in it of the 'Did-he-do-it' so characteristic of the Red-wattled species. It is a somewhat plaintive, bisyllabic *ti-ee*, punctuated by a high-pitched 'tittering' indulged in especially when the birds are agitated, as when their chicks are being handled.

Breeding: The gonads of the specimens were in an undeveloped condition. Col. Sparrow took several clutches of 2-4 eggs each at Trimulgherry and Eswantarāopēt between 16 May and 6 June, and Davidson and Wenden (S.F., vii, 88) found it breeding in the Bhīma Valley from May to July. At Kihim (Kolaba Dist., North Konkan) I have seen newly born (downy) chicks on 24 June.

Himantopus himantopus himantopus (L.). The Black-winged Stilt.

Charadrius himantopus Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 151—Southern Europe.

Specimen collected: 202 ♀ 30-10-31 Borgampād 160 ft.

Elsewhere noted at: Manānūr (Mrs. Tasker !); Deglūr.

Iris brown; bill black; legs and feet salmon pink; claws black.

The Black-winged Stilt was present singly or in small numbers round the margins of tanks. I found its distribution rather patchy; at Narsampēt with its numerous tanks, none were noted.

The ovaries of the specimen were in an undeveloped condition.

Family: Scolopacidæ.

Sub-family: Tringinæ.

Tringa ochropus Linnæus. The Green Sandpiper.

Tringa ocrophus (sic) Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 149—Europe, Sweden.

Specimen collected: 615 ♂ 26-3-32 Kaulās 1,300 ft.

Elsewhere noted at: Narsampēt, Kandahār, Deglūr, Ūtnoor, Kannad.

Iris brown; bill greenish horn colour, blackish at tips; legs and feet greyish green; claws black.

Small numbers of the Green Sandpiper were met with, usually singly, in the vicinity of tanks and flooded paddy-fields. Of 20 or more sandpipers seen at Gangannāpēt Tank at Ūtnoor on 1 April, only one belonged to this species, all the rest being *glareola*. The last recorded was on 16 April when most of these birds seemed to have departed.

The testes of the specimen were undeveloped, but it was completing body moult into breeding plumage. The wing- and tail-quills were fresh.

Tringa stagnatilis (Bechst.). The Marsh Sandpiper.

Totanus stagnatilis Bechstein, Orn. Taschenb., vol. ii (1803), p. 292—Germany.

Specimen collected: 549 ♂ 14-3-32 Deglūr 1,300 ft.

Elsewhere noted at: Manānūr, Narsampēt, Kandahār.

Iris brown; bill horny-brown, yellowish at chin; legs and feet olive-green; claws black.

Present in fair numbers by tanks, marshland and inundated paddy-fields.

The testes of the specimen showed signs of enlargement measuring ca 3×2 mm. The bird was in freshly moulted breeding plumage and was extremely fat indicating that it was ready for emigration to its northern breeding grounds.

Tringa hypoleucos Linnæus. The Common Sandpiper.

Tringa hypoleucos Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 149—Europe, Sweden.

Specimen collected: 233 ♂ 3-11-31 Borgampād 160 ft.

Elsewhere noted at: Hyderābād City Environs, Manānūr, Narsampēt, Mūkhēr, Deglūr, Hanamkonda, Aurangābād.

Iris dark brown; bill horny-brown, greyer at base of lower mandible; mouth pale French grey; legs and feet greenish-grey; claws dusky.

Commonly met with, singly, by tanks, streams, pools and puddles, flooded borrow-pits and the like. 14 March was the last date on which one was noted by the Survey, though at Alibāg (N. Konkan) I have seen one as late

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as 24 July while another was observed to frequent a tank throughout the monsoon.

The testes of the specimen were in a quiescent state.

Tringa glareola Linnæus. The Wood Sandpiper.

Tringa glareola Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 149—Europe, Sweden.

Specimen collected: 535 ♂ 12-3-32, 546 ♂ 14-3-32 Deglūr 1,300 ft.

Elsewhere noted at: Utnoor, Nīrmal, Aurangābād, Narsampēt.

Iris brown; bill blackish-brown, olive at base; legs and feet pale sage green or olive-green; claws brown.

This was the most abundant of the sandpipers met with in Hyderābād State, going about in small parties as well as in flocks of 20 to 30 birds or more, in inundated paddy fields (preferably where cut or newly grown), and by the marshy reed-covered edges of tanks. The last seen was on 14 April—a solitary bird.

The testes of the specimens were in non-breeding condition. No. 546 (14 March) was in heavy body moult, the rectrices and remiges being fresh.

Tringa totanus (Linnæus). The Redshank.

Scolopax totanus Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 145—Europe, Sweden.

Specimens not collected.

Noted at: Borgampād, Deglūr.

Pairs and small parties of Redshanks were observed on sandbanks in the Godāvari River, about its junction with the Kinārsāni. At Deglūr they kept to the edges of tanks.

Glottis nebularia Gunnerus. The Greenshank.

Scolopax nebularia Gunnerus, Leem, Beskr. Finm. Lapp. (1767), p. 251—Norway.

Specimens not collected.

Noted at: Borgampād, Deglūr.

Observed in small numbers—singly or in pairs or small parties of 3 or 4—on sandbanks in the Godāvari River. At Deglūr only a solitary example was seen at a tank (14-3-32).

Sub-family: Erolinæ.

Erolia temminckii (Leisler). Temminck's Stint.

Tringa temminckii Leisler, Nachträge zu Bechst. Naturg. Deutschl. (1812), pp. 63-73—near Hanau on the Main.

Specimen collected: 224 ♀ 2-11-31 Borgampād 160 ft.

Elsewhere noted?

Erolia minuta (Leisler). The Little Stint.

Tringa minuta Leisler, Nachträge zu Bechst. Naturg. Deutschl. (1812), p. 74—near Hanau on the Main.

Specimen collected: 548 ♀ 14-3-32 Deglūr 1,300 ft.

Elsewhere noted at: Hyderābād City Environs, Malkāpūr (along Nālgonda Road).

Iris brown; bill horny-brown, greenish at base of both mandibles; legs and feet olive-green; claws black.

Stints were seen in fair numbers at Borgampād, where they frequented mudbanks and spits in the Godāvari and Kinārsāni Rivers also marshy, cut paddy-fields by the edge of irrigation tanks. They were usually in flocks of 10-30 or more birds, flying swiftly, turning and twisting on the wing in orderly squad formation, and uttering a soft *wit-wit-wit*. In the other localities also, marshy country about irrigation tanks was their favourite haunt.

The ovaries of the specimens were in an undeveloped condition. In No. 548 (14 March) however, the follicles had a distinctly granulated appearance and the bird was moulting its primaries and coverts in preparation for its northern migratory journey.

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Sub-family: Scolopacinæ.

Capella gallinago gallinago (Linnæus). The Common or Fantail Snipe.

Scolopax gallinago Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 147—Europe, Sweden.

Specimen collected: 187 ♂ 29-10-31 Borgampād 160 ft.

Elsewhere noted and/or shot at: Nelipāka, Pākhāl Lake, Malkāpūr (along Nālgonda Road), Deglūr, Utnoor.

Iris dark brown; bill dark horny-brown, greyish-green at base of lower mandible and brownish-flesh at basal half of culmen; legs and feet greyish-green; claws black.

The Fantail Snipe visits the State in fair numbers during the cold weather, but in my experience it is not nearly so plentiful as the next species. Of 18 birds shot one morning at Nelipāka (12 November) only one belonged to this species, all the rest being Pintails. The bags in other places also invariably contained a much larger proportion of Pintails than Fantails. The birds frequent marshy grassland by the edge of tanks, and waterlogged cut paddy-fields.

A body moult apparently takes place on arrival in their winter quarters as seen in the case of birds shot and examined early in the season. The wing quills of all such birds were fresh, suggesting that these are moulted prior to starting on the southward migration.

The testes of the specimen, of course, were in an undeveloped condition. The latest record I have for this species is 8 April when 2 birds were flushed among reeds bordering a tank at Utnoor. One shot was in perfect fresh plumage and fat.

Capella stenura (Bonaparte). The Pintail Snipe.

Scolopax stenura Bonaparte, Ann. Stor. Nat. Bologna, vol. iv (1830), p. 335—Sunda Island.

Specimens not collected.

Noted and shot at: Borgampād, Nelipāka, Pākhāl Lake, Malkāpūr (along Nālgonda Road), Utnoor.

The Pintail Snipe, in my experience, is a much more abundant winter visitor to the State than the foregoing species. They were both found in the same type of country, and usually together. My remarks regarding moult apply to this species as well. The last to be shot or seen were 2 birds on 9 April (Utnoor) both of which were in perfect fresh plumage and very fat.

Order: Steganopodes.

Family: Phalacrocoracidæ.

Phalacrocorax niger (Vieillot). The Little Cormorant.

Hydrocorax niger Vieillot, Nouv. Dict. d'Hist. Nat., nouv. ed., vol. viii (1817), p. 88—India.

Specimens not collected.

Noted at: Narsampēt, Malkāpūr (along Nālgonda Road), Kandahār, Deglūr, Pākhāl Lake.

Present in small numbers on most tanks. When alighting on the water their tails are the first to break the surface and are employed as brakes to check the momentum.

Sub-family: Anhinginæ.

Anhinga melanogaster Pennant. The Indian Darter or Snake Bird.

Anhinga melanogaster Pennant, Ind. Zool. (1769), p. 13—Ceylon and Java.

Specimens not collected.

Noted at: Kāzipēt, Dornakal, Narsampēt, Malkāpūr, Utnoor.

Met with singly or in scattered pairs on tanks. In common with the Cormorants, they have the characteristic habit of perching on dry stumps etc. in the water or on bare trees at the edge, and spreading out their wings and tails to dry, on the model of the German eagle. These birds also use their tails as a brake when alighting on the water.

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Order: Herodiones.

Family: Ibididæ.

Threskiornis melanocephalus (Latham). The White Ibis.

Tantalus melanocephalus Latham, Index. Orn., vol. ii (1790), p. 709—India.

Specimens not collected.

Three or four birds were noted on a tank at Narsampēt on 1 December.

Pseudibis papillosa (Temminck). The Indian White Ibis.

Ibis papillosa Temm., Planch. Color. d'Ois. (1824), pl. 304—India and Ceylon.

Specimens not collected.

Noted at: Manānūr, Kāzipet, Nelipāka, Narsampēt.

This is not an uncommon species. Pairs and small parties of 3 to 7 or 8 birds were met with about jheels etc., also on the Godāvari River. Their cries or 'screams' are reminiscent of those of the Ruddy Sheldrake.

It is said to be common in the Bhīma Valley and to breed in May and again in the last three months of the year (Davidson and Wenden, S.F., vii, 92).

Sub-order: Ciconiæ.

Family: Ciconiidæ.

Ciconia ciconia (Linnæus). The White Stork.

Ardea ciconia Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 142—Europe, Sweden.

No specimens collected.

Noted at: Narsampēt (29-11-31), Devarkōnda (Mahbūbnagar Dist., 11-2-32 Mrs. Tasker !), Deglūr (15-3-32).

I only saw a party of 4 White Storks feeding on the reed-covered marshy edge of a tank near the town (Narsampēt) and a solitary bird in similar facies at Deglūr.

The red bills, which I particularly noted, would indicate that they belonged to the typical race.

Dissoura episcopus episcopus (Boddaert). The White-necked Stork.

Ardea episcopus Boddaert., Tabl. Pl. Enlum, p. 54 (1783) for Pl. Enlum. 906—Coromandel Coast.

No specimens collected.

Noted at: Borgampād, Pākhāl Lake, Āsifābād, Devarkōnda (Mahbūbnagar Dist. Mrs. Tasker !), Deglūr.

Usually seen in pairs, feeding on water-logged fallow land or the edge of tanks, or sailing in circles high up in the air in parties of 3 to 5 birds. On 7 December one was noted on a lofty tree in the forest near Pākhāl Lake beside a partially-built nest—a huge platform of twigs—at about 30 ft. from the ground. I am, however, not positive that the nest belonged to the bird though presumably this was the case. Davidson and Wenden (S.F., vii, 90) found it breeding in Sholāpūr Dist. in December and January, and in Satāra Dist. in February.

Xenorhynchus asiaticus asiaticus (Latham). The Black-necked Stork.

Mycteria asiatica Latham, Ind. Orn., vol. ii (1790), p. 670—India.

No specimens collected.

At Borgampād a pair was observed through glasses circling high overhead (3-11-31).

Leptoptilos dubius (Gmelin). The Adjutant.

Ardea dubia Gmelin, Syst. Nat., vol. i, pt. ii (1789), p. 624—India.

Not met with by the Survey.

Davidson and Wenden (S.F., vii, 90) and Fairbank (S.F., iv) observed the Adjutant in the Deccan, but record it as rare. Davidson saw one feeding with a lot of vultures.

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Leptoptilos javanicus (Horsf.). The Smaller Adjutant.

Ciconia javanica Horsfield, Trans. Linn. Soc., vol. xiii, pt. i (May 1821), p. 188—Java.

Not met with by the Survey.

Davidson and Wenden (S.F., vii, 90) write as follows: 'Wenden is sure that he has seen this bird on more than one occasion about the marshy tanks on the outskirts of the Nulwar jungles. It is, however, a very rare visitant, and seen in the rainy season only'.

Ibis leucocephalus leucocephalus (Pennant). The Painted Stork.

Tantalus leucocephalus Pennant, Ind. Zool. (1769), p. 11, pl. 10—Ceylon.

No specimens collected.

A flock of 5 birds was observed on a mudbank in the Godāvari River at Borgampād on 1-11-31.

Anastomus oscitans (Boddaert). The Open-billed Stork.

Ardea oscitans Boddaert, Tabl. Pl. Enlum. (1783), p. 55 for Pl. Enlum. 932—Pondicherry.

No specimens collected.

Small flocks were observed on jheels at Kāzipet (27-10-31) and Mūlūg (Warangal Dist., May 1927).

Sub-order: Ardeæ.

Family: Ardeidæ.

Ardea purpurea manillensis Meyer. The Purple Heron.

Ardea purpurea var. *manillensis* Meyer, Nova Acta Acad. Leop. Carol., vol. xvi, Suppl. (1834), p. 102—Philippines.

Specimen collected: 644 ♀ 4-4-32 Otnoor 1,250 ft.

Elsewhere noted at: Borgampād, Nelipāka, Narsampēt.

Iris bright yellow; bare lores and lower mandible greenish-yellow, upper mandible mostly horny-brown; bare tibia yellow; tarsus horny-brown; hind aspect of tarsus and soles of feet yellow.

Usually met with as a solitary bird standing motionless in water by river banks and islets or reedy tanks, darting forward with its bill now and again as some frog or fish comes within striking distance.

The ovaries of the specimen were in a quiescent state. It was undergoing a complete moult.

Ardea cinerea Linnæus. The Common Grey Heron.

Ardea cinerea Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 143—Europe, Sweden.

No specimens collected.

Noted at: Borgampād, along Nekōnda-Narsampēt Road and at Otnoor, singly as the foregoing.

Major-General E. F. Burton in his 'Reminiscences of Sport in India' (published about 1885) mentions a heronry close to a small village which he passed en route from Hanamkonda to 'Percall' Lake (Parkāl or Pākhāl?) in February 1847 where 'the great blue birds occupied all the topmost branches of the tall trees with their coarsely formed nests and straddled over their eggs and young in an ungainly way'. February (unless there is some oversight here) is much too early a month for these birds to have had young. The breeding season is usually in the monsoon months.

Egretta alba (Linnæus). The (Eastern) Large Egret.

Ardea alba Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 144—Europe.

No specimens collected.

Noted at: Kāzipet, Borgampād, Narsampēt, Devarkōnda (Mahbūbnagar Dist., Mrs. Tasker !), Deglūr.

Usually seen as a solitary bird on sandbanks in the Godāvari and Kinārsāni Rivers, also by marshy reed-bordered tanks. On one occasion 8 or 10 were seen together on a sandbank, presenting a magnificent sight.

Breeding: Col. Sparrow has two eggs from Navipēt, 10-8-14.

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Egretta garzetta (Linnæus). The Little Egret.

Ardea garzetta Linnæus, Syst. Nat., ed. xii, vol. i (1766), p. 237—'In Oriente'.

No specimens collected.

Noted along road between Achampēt and Hyderābād City, and at Kandahār. The birds were fairly common in the vicinity of water.

I seem to have overlooked *intermedia*, which I find not recorded in my field notes, but which must surely occur in this area.

Bubulcus ibis (Linnæus). The Cattle Egret.

Ardea ibis Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 144—Egypt.

No specimens collected.

Noted at: Hyderābād City Environs, along Nekōnda-Narsampēt Road, Kandahār, Deglūr, Ūtnoor.

The Cattle Egret is a common species in Hyderābād, usually seen in attendance on grazing cattle, picking up grasshoppers and other insects disturbed by the animals' progress through the grass.

In a ploughed inundated field near Narsampēt I noticed an assemblage of many hundreds of these birds, apparently for the benefit of the frogs!

Ardeola grayii (Sykes). The Indian Pond Heron or Paddy Bird.

Ardea grayii Sykes, P.Z.S. 1832 (22 November), p. 158—Dukhun.

No specimens collected.

Noted at: Manānūr, Borgampād, Narsampēt, Kandahār, Deglūr, Kaulās, Ūtnoor, Hyderābād City and Environs.

A common and familiar species frequenting tanks, ponds and even kutcha wells, and feeding principally on frogs.

On 9 October (Manānūr) some individuals were still in breeding plumage.

Breeding: At Navipēt on 10-8-14, Col. Sparrow found several nests with 3 or 4 eggs each in varying stages of incubation, and also large young.

Butorides striatus javanicus (Horsfield). The Indian Little Green Heron.

Ardea javanica Horsfield, Trans. Linn. Soc., vol. xiii, pt. i (May 1821), p. 190—Java.

Specimens collected: 542 ♂ 13-3-32 Deglūr 1,300 ft.; 661 ♂ 6-4-32 Ūtnoor 1,250 ft.

Elsewhere not noted.

Iris bright lemon yellow; upper mandible dark horny-brown, lower sage green; eyelids and bare patch in front of eyes bright yellowish leaf-green; legs and feet yellowish leaf-green, yellower on hind tarsus and soles; claws dusky.

On both occasions solitary birds were flushed from secluded, well-shaded rocky pools in stream beds. At Ūtnoor the stream ran through deciduous forest. Their stomachs contained mostly remains of crabs and frogs.

The testes of the specimens were undeveloped. No. 661 (6 April) was undergoing a body moult, the rectrices and wing-quills being unaffected.

Nycticorax nycticorax (Linnæus). The Night Heron.

Ardea nycticorax Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 142—Southern Europe.

No specimens collected.

Noted at: Pāloncha, Hyderābād City, Kandahār, Deglūr, Ūtnoor.

Usually seen flighting to and from their feeding grounds by tanks etc., at dusk and early in the mornings. Though often from the same roost, the birds do not fly in any kind of orderly flocks. They utter loud hoarse *quaak's* from time to time as they flap lazily along.

Order: Anseres.

Sub-family: Plectropterinæ.

Sarkidiornis melanota (Pennant). The Nukhta or Comb Duck.

Anser melanotos Pennant, Ind. Zool. (1769), p. 12—Ceylon.

No specimens collected.

Noted and/or shot at: Manānūr, Pāloncha, Narsampēt, Ūtnoor.

The Nukhta was present in small numbers on jheels and tanks. At Ūtnoor only a solitary bird was seen (5 April). On 11 October (Manānūr) a duck was observed on a tank accompanied by 14 half-grown ducklings. She refused to

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1. Paddy-bird (*Ardeola grayii*) wading after Frogs.

2. Green Sandpiper (*Tringa ochropus*) in full plumage preparatory to emigration. Late April.

Photos by Author.

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forsake the brood even when her mate (?) and another duck of the party flew away to the report of shots close by. As late as 25 November (Pāloncha) also, another bird was noted to be accompanied by 3 half-grown ducklings.

Sub-family: Chenonettinæ.

Nettapus coromandelianus (Gmelin). The Cotton Teal.

Anas coromandeliana Gmelin, Syst. Nat., vol. i, pt. ii (1789), p. 522—Coromandel, India.

Specimens collected: 405 ?, 406 ? (imm.) 2-12-31 Narsampēt 800 ft.

Elsewhere noted at: Hyderābād City Environs, Malkāpūr (Nālgonda Road), Ōtnoor.

Iris dark brown; bill, upper mandible plumbeous-brown, lower pale dull orange-flesh colour; legs and feet greyish-green; claws brown.

This little teal is a fairly common resident in the State and is present in some numbers on most tanks and jheels. The largest flock seen was of about 50.

No. 406 (2 December) was a young bird with soft skull, just growing its wing-quills.

Sub-family: Anatinæ.

Dendrocygna javanica (Horsfield). The Lesser or Common Whistling Teal.

Anas javanica Horsfield, Trans. Linn. Soc., vol. xiii, pt. i (1821), p. 199—Java.

Specimens collected: 407 ? 2-12-31 Narsampēt 800 ft.

Elsewhere noted at: Manānūr, Borgampād, Deglūr, Ōtnoor, Hyderābād City Environs, Malkāpūr (along Nālgonda Road).

Iris dark brown; eyelids dull chrome yellow; bill slaty-black; legs and feet slate colour.

The Lesser Whistling Teal is one of the two commonest resident ducks in the State, the other being the Cotton Teal. It usually keeps in flocks of from 8 to 30 birds or more, of which one or two will be found on every jheel of any size.

On a tank at Narsampēt, a pair were seen accompanied by 3 half-grown ducklings on 2 December.

Dendrocygna fulva (Gmelin). The Large Whistling Teal.

Anas fulva Gmelin, Syst. Nat., vol. i (1839), p. 530—Novo Hispania.

Not met with by the Survey.

Davidson and Wenden (S.F., vii, 92) write: 'W. is sure he has observed this species at Nulwar and shot several in 1873'. Fairbanks (S.F., iv) also obtained a pair once near Ahmadnagar, but this was the only occasion on which he came across the species.

Casarca ferruginea (Pallas). The Ruddy Sheldrake or Brahminy Duck.

Anas ferruginea Pallas in Vroeg, Cat. d'Ois. Adumb. (1764), p. 5—Tartary.

No specimens collected.

Noted only at Nelipāka where small parties were frequently seen flying up and down the Godāvari River and resting on the sandbanks.

Anas pœcilorhyncha J. R. Forster. The Spot-bill or Grey Duck.

Anas pœcilorhyncha J. R. Forster, Zoöl. Indica (1781), p. 23, pl. 13, fig. i—Ceylon.

No specimens collected.

Noted and/or shot at: Manānūr, Malkāpūr (along Nālgonda Road), Deglūr.

Found on tanks and jheels in small numbers.

Nettion crecca (Linnæus). The Common Teal.

Anas crecca Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 125—Europe, Sweden.

No specimens collected.

Noted and/or shot at: Aurangābād, Pālonchā.

Present on tanks etc. in small numbers, along with other species. Also observed in flooded borrow-pits by road.

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Querquedula querquedula (Linnæus). The Garganey or Blue-winged Teal.

Anas querquedula Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 126—Europe, Sweden.

No specimens collected.

Noted and/or shot at: Deglūr, Malkāpūr (along Nālgonda Road), Utnoor.

Seen in flocks of 50 or more on tanks and jheels. It is an inveterate diver and swims well under water. This species is one of the earliest of the migratory wildfowl to arrive in India and also the latest to leave. A flock of 8 was seen at Utnoor on 9 April when no other migratory ducks were present.

Spatula clypeata (Linnæus). The Shoveller.

Anas clypeata Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 124—Europe, S. Sweden.

No specimens collected.

Noted and/or shot at: Borgampād, Deglūr, Utnoor (15-10-24), Malkāpūr.

The Shoveller is fairly common on tanks and jheels, but not numerous. It keeps in small flocks of 6-8 birds.

Sub-family: Nyrocinæ.

Nyroca ferina (Linnæus). The Pochard or Dun Bird.

Anas ferina Linnæus, Syst. Nat., ed. x, vol. i (1758)—Europe, Sweden.

No specimens collected.

Noted and/or shot at: Hyderābād City Environs, Malkāpūr, Kandahār, Deglūr.

A fairly common species on tanks and jheels.

Nyroca fuligula (Linnæus). The Tufted Pochard.

Anas fuligula Linnæus, Syst. Nat., ed. x, vol. i (1758), p. 128—Europe, Sweden.

No specimens collected.

Noted and/or shot at: Malkāpūr, Devarkōnda (Mrs. Tasker !), Kandahār, Deglūr.

A common species in winter on irrigation and village tanks and jheels, often in large numbers.

I have no doubt that a good many species of duck besides those mentioned above must occur within our limits during the cold weather months. Duck-shooting on the whole, however, is rather poor in the Hyderābād State as the tanks on which the birds are mostly found are artificial reservoirs for irrigation purposes where the water is usually too deep or too open to supply the requirements of the sport. It is interesting to read in Major-General E. F. Burton's 'Reminiscences of Sport in India' the description of a journey from Hanamkonda (then a military station occupied by the Hyderābād Contingent) to 'Percall' Lake, thirty miles 'through wild country studded with fine sheets of water which were full of ducks and geese of all kinds'. The geese most probably were of the Bar-headed species (*Anser indicus*) which doubtless even now visit parts of the State in the cold weather. The nearest place to the Hyderābād State where I have come across them is on the Godāvari River near Nāsik.

Order: Pygopodes.

Family: Podicepidæ.

Podiceps ruficollis (Pallas). The Indian Little Grebe or Dabchick.

Podiceps ruficollis Pallas in Vroeg. Cat. d'Ois. Adumb. (1764)—Holland.

No specimens collected.

Noted at: Hyderābād City Environs, Manānūr, Kāzipēt, and along the railway line to Dornakal, Narsampēt, Malkāpūr, Kandahār, Deglūr, Utnoor, Nīrmal.

A common species throughout the State, almost invariably present on tanks and jheels. A pair was also noted in the moat surrounding Kandahār Fort.

Breeding: Col. Sparrow has taken several clutches of the Dabchick's eggs (usually 6) at Mulkaram, Eswantarāopēt and elsewhere, between 26 July and 9 September.

(*The end*).

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EARTH-EATING AND SALT-LICKING IN INDIA.

BY

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AND

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(*Continued from page* 981 *of volume* XXXVI).

ANALYSES XXXII-XXXV.

XXXII.—COMMON EARTH.

SERIAL NO. 28.

LOCALITY.—Near Murtiha in the Reserved Forest of Bahraich District, United Provinces.

COLLECTED AND SENT BY—The Divisional Forest Officer, Bahraich.

Cement-grey, friable lumps with rootlets. Powder soft.

Minerals	0·79	per cent.
Clay	9·19	,,
Sand	84·59	,,
Organic debris	2·13	,,
Humus	0·35	,,
Moisture	2·96	,,
Fine Earth (20 mesh sieve)	96·103	,,
Insoluble in nitric acid	77·611	,,
Soda (Na_2O)	1·681	,,
Potash (K_2O)	0·588	,,
Magnesia (MgO)	0·431	,,
Lime (CaO)	0·449	,,
Alumina (Al_2O_3)	1·946	,,
Silica (SiO_2) soluble	6·630	,,
Sulphur (SO_3)	0·003	,,
Phosphorus (P_2O_5)	0·147	,,
Ferric oxide (Fe_2O_3)	3·146	,,
Moisture and organic matter	5·155	,,

Remarks.—1. The earth was taken within 100 yards from, but outside, Salt-Lick No. 27.

2. 'The earth from the salt-lick is very hard and unmistakeable, and that from the adjoining area is easier to break and crumble.' (D. Davis, Esq., I.F.S.).

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XXXIII.—Common Earth.

Serial No. 46.

Locality—Gonda Forest Division, Bhambar Range, Chandanpore Block.

Collected and sent by—The Forest Ranger, Bhambar Range, United Provinces.

Hard buffy lumps crumbling to powder. Powder soft.

Clay	5·41	per cent.
Sand	91·19	,,
Organic debris	2·07	,,
Moisture	0·19	,,
Fine Earth (20 mesh sieve)	99·37	,,
Insoluble in nitric acid	81·454	,,
Potash (K_2O)	3·196	,,
Magnesia (MgO)	0·269	,,
Lime (CaO)	0·312	,,
Alumina (Al_2O_3)	2·052	,,
Silica (SiO_2) soluble	7·310	,,
Ferric oxide (Fe_2O_3)	2·002	,,
Moisture and organic matter	2·940	,,

Remarks.—1. The soil contains traces of humus and phosphorus.

2. The earth was collected at a distance of about a chain from Salt-Lick No. 47, on the left in cpt. 101 B.

XXXIV.—Soil from Salt-Lick.

Serial No. 47.

Locality—Gonda Forest Division, Bhambar Range, Chandanpore Block, United Provinces.

Collected and sent by—The Forest Ranger, Bhambar Range, United Provinces.

Hard buffy lumps crumbling to powder. Powder soft.

Minerals	0·06	per cent.
Clay	10·34	,,
Sand	86·58	,,
Organic debris	1·76	,,
Humus	0·08	,,
Moisture	1·09	,,
Fine Earth (20 mesh sieve)	99·532	,,
Insoluble in nitric acid	83·519	,,
Potash (K_2O)	1·213	,,
Magnesia (MgO)	0·283	,,
Lime (CaO)	0·230	,,
Alumina (Al_2O_3)	3·432	,,
Silica (SiO_2) soluble	6·725	,,

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Phosphorus (P_2O_5)	0·916	per cent.
Ferric oxide (Fe_2O_3)	1·552	,,
Moisture and organic matter	2·110	,,

Remarks.—1. The soil contains traces of manganese.

2. (*a*) The earth was collected on the right of Chandanpore-Nerhewa 15 ft. road in cpt. 103A, about 500 yds. from Chandanpore Forest Rest-house.

(*b*) Cows, deer, chital, sambhar, barking deer, four-horned deer, and sometimes pigs, porcupine, and langoor black-faced monkeys visit these licks. In some places cattle are very fond of it; so much so that if they are not driven away by their owner, the animals will overfeed and kill themselves.

(*c*) All the wild animals visit the Kila at night, but sambhar are always late comers. They lick salt all the year round, but mostly in wet weather when the earth is soft. October is the best period for the wild animals.

(*d*) 'The reason why they take to this is that it acts on them as a purgative and feel refreshed after they have taken it.' (Ganga Ram. F.R.O.).

XXXV.—Soil from Salt-Lick.

Serial No. 48.

Locality—Sironcha Range, Chanda District, Central Provinces.

Collected and sent by—The Deputy Conservator of Forests, South Chanda Division.

Friable grey lumps with a few rootlets. Powder gritty and soapy to the touch.

Minerals	2·84	per cent.
Clay	5·47	,,
Sand	82·55	,,
Organic debris	4·83	,,
Moisture	3·86	,,
Fine Earth (20 mesh sieve)	93·408	,,
Insoluble in nitric acid	64·646	,,
Soda (Na_2O)	0·891	,,
Potash (K_2O)	0·960	,,
Magnesia (MgO)	0·452	,,
Lime (CaO)	0·580	,,
Alumina (Al_2O_3)	4·872	,,
Silica (SiO_2) soluble	12·180	,,
Sulphur (SO_3)	0·117	,,
Phosphorus (P_2O_5)	1·497	,,

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Ferric oxide (Fe_2O_3) ...	...	....	1·321 per cent.
Moisture and organic matter ...		....	4·850 ,,

Remarks.—The following animals visit the salt-licks specially in rains when the ground is soft:—

Elephants, buffaloes, bisons, barasinga, blue bulls, sambars, chitals, other kinds of deer, pigs, monkeys, all domestic cattle. They lick this earth and drink water as well collected in salt-lick areas to have a change of taste after their daily feed. They eat this earth in excess when they want to clean their bowels or when they get eruption on their tongue. (Range Officer, Sironcha Range).

Additions and Corrections.

Journ. Bomb. Nat. Hist. Soc., vol. xxxvi, No. 1, November 15, 1932, p. 219.

XVI.—Serial No. 81. *Remarks.*—2. The lick lies between Wain and Balahama about eight miles out of Srinagar, Kashmir, at a distance of about two miles from Khanmoo Rukh Big Game Reserve, which is a part of the lower ranges of Kashmir mountains. The lick is a mound on small rising ground in the field at the foot of the above range.

3. It is in the winter months only that the stags in numbers come out of the Khanmoo Rukh and lick the earth all round this hillock and everywhere on it. They have a great liking for it.

XVII.—*Soil from Salt-Lick* to read *Common Earth.*

XVII.—Serial No. 82. *Remarks.*—2. The earth was collected from an area adjoining Salt-Lick No. 81.

P. 224—XXV. Serial No. 156. *Remarks.*—2. The place was a little cliff about 6 ft. high, its foot sloping down to a shallow ford in a small stream. Both the ford and the foot of the cliff showed every sign of being much frequented by sambar, cheetal, and barking deer; but there were no sign of bison or tiger or panther foot-prints. The jungle-man with me pointed out porcupine foot-prints actually at the salt-lick . . . There has been a good deal of rain in these parts in the last week, and the soil between the cliff and the stream was all puddled and soft, and so was much of that at the actual foot of the cliff.

3. The sample was collected from the central boss of plastic clay encircled by a smooth channel, about 12 in. or 15 in. in radius; the channel possibly made by deer's chins or tongues, I can't be sure which, it being about 3½ in. across and 2½ in. deep. The central boss bore distinct tongue marks as having been licked, and also queer flat impressions, mixed up with the lick marks, and with a distinct sort of golf ball 'bramble' marking pattern on them. Whether these can have been caused by the tongue being laid on the earth and lifted with a sucking effect I do not know . . . The porcupine foot-prints were seen on this central boss . . . Deer had knelt to get their heads down to this spot . . . Other parts of the cliff at the same point showed less regular marks of being licked and bitten.

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Vol. xxxvi, No. 4, December 15, 1933, p. 978.

XXVI.—Serial No. 157. *Remarks.*—3. A few feet further along there was a part of the cliff about 4 ft. from the ground level where the earth was hard and dry and which showed fresh marks of being bitten. I collected a sample of this also (No. 157). The foot of the cliff at this point also was puddled and plastic and had a straight channel very much like the circular channel referred to above (cf. No. 156). Apparently showing that at the time some of the deer were at it last night. The earth was very much more liquid; one could see drops of solidified mud lodged on a bank some 3 ft. high just above the end of this channel. These drops must have dropped off their chin.

XXVII.—Serial No. 13. *Remarks.*—2. The sample is from the South Banda Range of the Banda Forest Division. These forests are on the Vindhya Range and Panna Plateau.

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REVIEWS.

I. EVOLUTION OF HABIT IN BIRDS. By Edmund Selous, 296 pages, London, 1933 (Constable & Co. Ltd.).

For many years now, the name of Edmund Selous has been well to the fore amongst ornithologists and nature-lovers. His excellent field studies of living birds presented to us through the pages of various natural history magazines and journals, have earned him just renown and have, moreover, been largely responsible for the happy change that has come about in recent years in the attitude of the 'scientific' or 'museum' ornithologist towards the value and importance of this type of research. Field observation had come to be regarded in 'museum scientist' circles with something akin to contempt or at the most with a species of benign indulgence as being merely 'bird-lore' and of little or no scientific value.

Fortunately for science, things have taken a healthier turn and it is now becoming increasingly recognised that the contribution which intelligent and rational field observation can make in unravelling many of Nature's puzzles is as great, if indeed not greater than any the pure museum worker (Systematist or Classification-monger, as the author feelingly calls him !) with often merely a pile of dry stuffed skins at his disposal, can. In other words it is becoming increasingly clear that to understand the ecology, i.e. the relation of an organism to its surroundings, its affinities with other creatures and its position in the general scheme of Nature, field observation is the only dependable *via media*. While systematic work and classification are also indispensable to a proper understanding of such problems, they are likewise only a means to the end and not the end itself.

In the present volume the author has attempted to show how his own observations on many different species of living birds have brought him to the conclusion that all or most of the habits noticeable in this group at the present day are the outcome of something more fundamental than appears on the surface, and that many of them can be directly attributed to the subtle influences of sex, i.e. that many of the habits which we see crystalized among our modern birds have a sexual origin, and being of direct benefit to the species, have been worked upon and evolved by Natural Selection, a factor to which the author attaches cardinal importance. Such acts among Stock Doves and Stone-Curlews as the assuming of bellicose and ludicrous postures without engaging in actual serious combats are, he believes, where fighting has passed into formality to the benefit of the species, since actual encounters in strong and well-armed birds would result in heavy mortality to the detriment of the race. These mock battles, martial displays and sabre-rattling which the author terms 'Formalisation', have according to him clearly grown out of real fights, thus resulting in 'the proportionate dissipation through Natural Selection of energies that have become to any extent deleterious, into channels entirely or comparatively innocuous.' He suggests that 'Formalisation' is only practised *inter se* i.e. between rival individuals of the same species, but that against an outside enemy like a dog it is still capable of turning into actual and serious fighting.

In another part of the book entitled 'Sexual Origin of Nest-building' the author attempts to demonstrate by a copious citation of his notes relating to the Peewit, Blackbird, Flycatcher and other species, that nidification has been slowly developed out of physiological reaction to sexual stimulus. He affirms—and we think with reason—that the origin of nest-building can never have been purely architectural. It is pointed out that in the case of the Lapwing's nest, the scrape in which the eggs are laid has originated not as a deliberate and thought-out plan, but merely accidentally from the bird's observable habit of pressing its breast down and turning round and round excitedly, when its actions are exactly the same as in the act of copulation. The movements are indulged in principally by the male in the breeding season, probably as

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an outlet to his exuberant and surplus energy. Bits of grass etc. are torn up at the same time from the immediate surroundings and allowed to drop at the sides and find their way into the scrape, suggesting or explaining the origin of the lining.

Many other topics of absorbing interest are discussed in other chapters, such as Origin of Sexual Display in Birds, Suggested Origin of Darwinian Selection, Origin of Domestic Cleanliness, Parental Care of Young, and Song in Birds, based on the author's field observations.

We have nothing but admiration for the painstaking manner in which the author has recorded his field observations and collected his data, and for the ingenuity with which he has interpreted it. In a footnote somewhere, he says 'My idea is that in serious field natural history, by which I mean the kind into which thinking as well as seeing enters, every reader is entitled to the actual field notes of the author where these exist and are pertinent. True, he may not want them, but in that case the serious element is absent on *his side*.' Acting upon this principle the author has filled his book with copious notes in which many observations often also those not immediately bearing on the subject in hand, are brought in. While we agree that every reader is entitled to the field notes of an observer, we think some better and more convenient method should have been devised—such as in an appendix—for presenting them rather than in the actual text. The procedure now adopted tends to make the style unnecessarily involved, and it is often quite difficult for the reader not to lose the thread of the author's arguments and reasoning, or to arrive at the conclusions he is expected to.

The book is nevertheless a stimulating, and in many respects an original one. It provides plenty of food for thought to scientist and layman alike, and deserves to be read by all naturalists and bird-lovers.

S. A. A.

II. NATURE STUDY READERS. The Teachers' Scheme Book for First and Second Year Pupils. By Phyllis S. Darling, M.R.S.T., F.R.G.S. (Oxford University Press). Price As. 8.

One of the greatest obstacles in the teaching of Nature Study in Indian schools has been, and still is, the lack of teachers who are themselves familiar with the subject. The ordinary teacher in primary, secondary and even high schools, is usually as much a stranger to Nature Study as are his pupils, and it is therefore not surprising that he should often resent this further addition to the already long list of subjects he is expected to teach. Even among better qualified teachers, including those possessing an academic degree in Natural Sciences, there are very few endowed with the gift of bringing their knowledge down to a level where it will be readily intelligible to the children. Neither is it sufficient for the teacher merely to make himself understood, for unless he can at the same time succeed in arousing the necessary interest in the child and creating in his pupil a thirst for further knowledge and investigation, the essence of Nature Study teaching is lost.

With a view to easing the lot of the average school teacher, primarily, a series of Nature Study Readers is being written by Mrs. Darling, the first of which had already been published while others are in course of preparation. The aim of the present booklet is to help teachers in inculcating in their pupils a love of Nature and a spirit of independent enquiry and research which will goad them on to observing and investigating things for themselves and finding out the answers to their difficulties without recourse to continual assistance and 'spoon-feeding'. This admittedly is the true aim and purpose of Nature Study teaching.

The readers will supply a real and long-felt want and we hope they will receive the encouragement they deserve from educational institutions in this country. We also hope that in course of time they may be translated into the vernaculars so as to be available to teachers in village schools who are often ignorant of English.

S. A. A.

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III. INDO-CHINA, A SPORTSMAN'S OPPORTUNITY. By Archibald Harrison, made and privately printed at the Mayflower Press, Plymouth, 1933, 157 pages with 12 photographs and a sketch map of itinerary of the trip.

Archibald Cary Harrison, an American sportsman, died in London in 1928 and this record of his experience in Indo-China during a hunting expedition undertaken in 1917 is now privately printed by his daughter and his elder brother.

It is evident from the Foreword, dated May 1918, and other indications in the book, that Archibald Harrison intended at one time to publish this record of his observations and experiences in a French colony, but we do not know why the manuscript was laid by for the ten years before his death.

The book is interesting as introducing the reader to a little known country of which the big game possibilities *were* very attractive; but are they so now? The Game Laws for the Province of Lang-Biang provided that in the Reserved Zone in which the Harrison expedition hunted, the Special License (200 piastres), good for three months in the year only allowed one elephant, one gaur, three wild cattle, *and only males*, to be shot; all other beasts except tigers and panthers being protected. In the Protected Zone the law was strict for all forms of game and there was a summer closed season; in the Free Zone a male gaur could be killed for 30 piastres.

The author remarks that these regulations, framed by Mr. Millet and introduced in February 1917, 'will be bound to conserve the game and become important when Annam gets into the sportsman's eye'. From a perusal of the book the obvious remark has to be made that no game laws can be effective if the Forest Officer responsible for their enforcement permits flagrant disregard of them in his presence and actively connives at the slaughter of cows and hinds!

At the time of Archibald Harrison's expedition—13th June to 8th August, 1917—the striking feature of this region to sportsmen was that it was quite unspoiled. Previous visits had been by one famous Frenchman who 'slew widely'; and several Belgians and Germans before the War; besides these had been only the trips of his brother F. B. Harrison, and one or two Americans from the Philippines.

Indo-China consists, as A. H. tells us, of Cochin China, a colony, Tonkin, Laos, Cambodia, and Annam which are protectorates in charge of native Emperors who 'rule' under strictly French supervision. The shooting was done in the sub-division of Liang-Biang in Southern Annam, a narrow strip touching for its entire length the China Sea.

The terrain is mountainous and the climate perfect, the wanderings of the party taking them from five to six thousand feet above the sea. Although it was supposed to be the rainy season most of the days and nights resembled those of September and October in the State of Maine. Occasionally heavy thunderstorms disturbed the afternoons. The relief of getting to the shooting country was a transportation from heat and paddy fields to pine trees and blankets. The forests are described as being in general fairly open, of pine and other large trees, with frequent glades and meadows, the undergrowth knee high, coarse grass growing from soil soft enough to make the tracking of heavy animals possible. The inhabitants are Mois, a simple and friendly tribe of aborigines, gentle savages without any terror or suspicion of the visitor from outside, and both men and women carry a surprising pack willingly, and all day. They were scrupulously honest.

So we realize what a wonderful country is there, on the shores of the China Sea but a thousand miles from Hong Kong, and it is a thousand pities that such sportsmen as E. C. Kirkendall should have ravaged it, and that Archibald Harrison should have had him as a shooting companion. For A. H. was, we realize during perusal of his book, a true sportsman refraining from useless slaughter and at heart, as his brother says of him, a true conservationist of game.

A list of the principal game animals and birds, the former including the python, cobra, and monkeys of eight varieties, closely corresponds to the fauna of Burma. The list is French and says that there are of gaur 3 varieties, of wild cattle 2, of panthers 2, of bear 3, of wild dog 2, and of wild hog 2. Nothing is said in the book about these varieties so we are left to conjecture

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what they may be. As to the bear and panther one can make a probably accurate guess; but of the others? It would be interesting to have more information.

Mr. Millet of the French Forestry Service was the guide, philosopher, and friend of the party. 'I never had a better shooting companion nor a more expert one'; but it has to be remarked that, although the Game Laws were drawn up by him, conservation of game was not one of his strong points, nor was he a naturalist.

The four tigers shot were obtained by a method originated by Mr. Millet 'the only sure way of killing them'. A. H. remarks that he never heard of the use of a stationary bait in India. Certainly it is not the custom in India to lead an unsuspecting kill to the foot of a stout tree and shoot it behind the ear with a revolver; but both in India and Burma baits are, when beating is not intended, so tied that they cannot be dragged away: and it is a usual practice in parts of Burma to leave out the carcase of any large animal which may have been shot and visit it in the hope that a tiger may have been attracted to the feast. Some of us have essayed Mr. Millet's method of an approach path swept clear of leaves to give noiseless access to a loop-holed screen of branches, but not in the systematic fashion here described.

An instance of a tigress covering up a kill with grass is cited; a not unusual occurrence, as recently remarked in connection with Mr. Peacock's book on Burma. It is said on Mr. Millet's authority that panthers turn away from carrion, but that is not at all correct. Night shooting of tiger did not appeal to A. H.; he preferred his nights in bed.

Mr. Millet was evidently responsible for the several observations as to the habits of tiger. 'The tiger tears off the skin (of a carcase) like tissue paper'; 'if hungry they come with a roar and throw themselves upon the carcase'; a female of this species gives birth at irregular intervals, often several years apart, and takes care of the little ones for a time, moving them from place to place. A singular instinct then causes her to eat all but one of the babies a saving grace for the rustics, otherwise the country would be overrun with tigers'. These are truly remarkable Natural History observations.

It is seen by the measurements given that the Annam tiger is a lightly built animal as compared with the tiger of India. The largest shot had a body length of 5 ft. 11 in. with a girth of but 41½ in. There appeared to be a great many tigers in that country, many of them maneaters, and 'there is a vast supply awaiting the generations to come'.

'Kirkendall and Millet celebrated the Fourth of July by killing four gaur and wounding a fifth (one allowed on the license!) practically demolishing a herd'; and again, 'Kirkendall and Millet had the good luck, during a day on which I had chosen to stop in camp, to fall in with a troop of gaur . . . Three cows and an exceptionally heavy bull paid the penalty, while a second bull dragged itself off sorely wounded'; once more, 'Kirkendall at length covered himself with ambiguous glory by killing an adult cow (wild cattle) and mortally wounding another' and lastly, 'Kirkendall fired four times landing once through the intestine. That he died of gangrene there is no question'. 'Kirkendall, insatiable . . . . amused himself at Da-Nhim in pursuing *con-nai* (sambur) at night with an electric torch device pinned on his campaign hat. There is no law against it as in most other countries in the world . . . . His first evening's "jacking" was a towering success; he bagged a full grown buck and doe with two shots along the maccadam road'.

Enough of this butcher Kirkendall. It is a thousand pities that A. H. had him with him on this trip. It must not be thought that Harrison intentionally pillories his friend; the book does not in the remotest degree read like that. The best of two gaur bulls had a spread of 38½ in. A. H. was himself a good sportsman. All through the book there are remarks and observations which clearly indicate that he was a forbearing sportsman with no desire for unnecessary slaughter. He shot two of the tigers, a bull gaur, and a bull *kron* (wild cattle). Only once did he fire at a deer the whole trip and shot no sambur, going home with but an old horn or two picked up in the woods. It is good to read that the party did not fire at the brow antler deer, of which there were plenty. Millet was the formulator of the recently introduced game laws yet, 'Our guardian even pulled off a fine shot himself at a doe (sambur) at three hundred yards'.

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The chapters on 'Miscellaneous Game', 'Camps and Side Issues', 'Mois, Annamites, and Generalities', are readable and informing on many matters.

The American rifles were found to shoot high and there were futile stalks and days of hunting owing to want of knowledge of what the rifles would do; 'They shot high at from 50 to 200 yards. It took us some weeks to get in the habit of proper allowance'. They found the bulls of the wild cattle more difficult to come by than the bison. The photographs do not show that heads much worth having were obtained.

Villagers are restricted to native arms—spears and cross-bows,—and are no doubt adepts in the use of poisoned arrows, for they trade largely in skins. They are not permitted to trap, but one reads elsewhere that they are expert trappers.

In this Review pretty well all that calls for remark has been noticed, and it is because the book is not available to the general public that it has been treated at such length.

Archibald Harrison was a man of lovable character. He died at the comparatively early age of fifty-two.

R. W. B.

IV. 'DARWIN'. By R. W. G. Hingston (Duckworth, London. 2s.).

The readers of the Society's *Journal* need no introduction to the author of the volume under review; his delightful series of articles on the life and biology of spiders, ants and other insects published in the *Journal* a few years back are well known to all of us. He is also the author of 'A Naturalist in the Himalayas', 'A Naturalist in Hindustan', and 'A Naturalist in the Guiana Forest'.

The work under Review is the first attempt by the author in the biographical line. It contains a careful and fairly detailed account of the life and work of the great naturalist and biologist, Charles Darwin, and is one of the series of small volumes entitled 'Great Lives' published by Messrs. Duckworth & Co. Each of these volumes reviews briefly the life and work of celebrities in various branches of learning, Art and Science, and provides at a moderate price handy biographies such as should enable the lay public to get an idea of the life and work of these great men.

Hingston's 'Life of Darwin' is not planned on the ambitious scale of the famous biologist's life in three volumes edited by his son Francis Darwin, but deals in six chapters with his ancestry, early years, schooling, University education, and traces the history of his monumental work in connection with the theory of Evolution. Darwin's father, who was himself a successful physician, wanted that his son should follow in his footsteps, but after repeated attempts both in Shrewsbury Grammar School and later in the University of Edinburgh he found it impossible to carry on with the training necessary for a medical student and after long cogitations the clerical profession was decided upon. With this end in view he shifted to Cambridge, but was only able to get an ordinary B.A. degree. During his stay at Cambridge, however, he under the guidance of Henslow and Sedgwick had obtained a general, though not intensive, training as a naturalist. Fortunately for Natural History, the Admiralty brig 'Beagle' was about this time starting on its round-the-world voyage, mainly for the survey of the South American coast line but also intending to carry round the world a chain of chronometrical measurements. As the author very rightly points out, Darwin when he set out on this voyage, was totally unacquainted with his powers and only expected 'to accumulate collections for the big guns to classify in obscure periodicals', but in his new school on board the 'Beagle' 'he developed with riotous precocity' and collected material which provided the necessary withal not only for the wonderful account of 'A Naturalist's Voyage Round the World', but also the materials for his theory of the formation of Atolls and Coral Reefs and geological observations on volcanic islands etc. It was during this voyage that Darwin had begun to consider the problem of the origin of species and its bearing on Evolution. 'Darwin did not initiate the idea of Evolution. What he did was to resurrect

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it and demonstrate its truth' by careful studies on domestic animals and several years of 'pondering and investigation'. In three chapters Hingston gives a most delightful summary of Darwin's work not only as a zoologist but also as a geologist, botanist and, above all, a biologist with an exceptionally fruitful mind for discovering and collating the facts involved in the study of Evolution.

The little book is written in a delightful style and both the author and the publishers are to be congratulated on a beautifully got-up volume which they have been able to produce in such a short compass and at so low a price.

B. P.

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OBITUARIES

ETHELBERT BLATTER, S.J.

It is with the deepest regret that we record the death of Reverend Father Ethelbert Blatter, who passed away peacefully on Saturday evening, the 26th May (1934) at 6-45 p.m. at St. Vincent's High School, Poona.

Father Blatter was born in Switzerland on the 15th December, 1877. The Blatters hail from the Swiss Canton of Appenzell stretching around the slopes of the majestic Saentis. He lost his father very early in life and grew up in the castle above the village of Rebstein, in the valley of the young and boisterous Rhine. The Rebstein Castle belonged to Fr. Blatter's uncle, a very popular doctor in that corner of the Canton of St. Gall. After the death of Dr. Blatter, the romantic place, which had been built in A.D. 1207, was acquired by a charitable industrialist of Rebstein and is now a boarding house for factory girls in charge of motherly nuns.

After his elementary education in the village school, young Ethelbert went to the college (high school) of Sarnen, in the Canton of Obwalden, in Central Switzerland. Classmates still talk of the brilliant youngster who simply played with every subject of the classical course, and quite as readily with the good Benedictine Fathers. But all are agreed that there was a certain frank nobleness about the jolly schoolboy. His countless pranks were conceived in the spirit of fun and hurt nobody. He was bursting with buoyancy and could not suppress the Appenzeller in him. The Appenzellers are renowned for their wit, and famous for their quick repartee. Blatter excelled in both. The last years of student-life he spent in the college of Schwyz at the foot of the imposing twin peaks of the Mythen. A colleague referring to this period (Schwyz) writes: "There I came to know him, when I was still in the 'small division'. Ethelbert was soon the hero of the school as he had been at Sarnen. He was easily first in class, and on the stage, and . . . would you believe it?—could run in the playground like a deer, although his physical proportions were relatively the same as when he was the Reverend Principal of St. Xavier's College, Bombay. Only those who did not know young Blatter sufficiently were astonished, when from Schwyz he went to Feldkirch in Austria to join the Noviciate of the German Province of the Society of Jesus." It was very often jokingly said that young Blatter had been in every school in Switzerland.

Blatter joined the Society of Jesus on the 1st October, 1896. Two years later he went to Holland to brush up his classical studies. At that time the German Jesuits were in exile under the Bismarckian law, and the so-called Juniorate was a very lonely place in the Dutch heath. Philosophy followed in the fine college of Valkenburg, somewhat closer to the German frontier and quite

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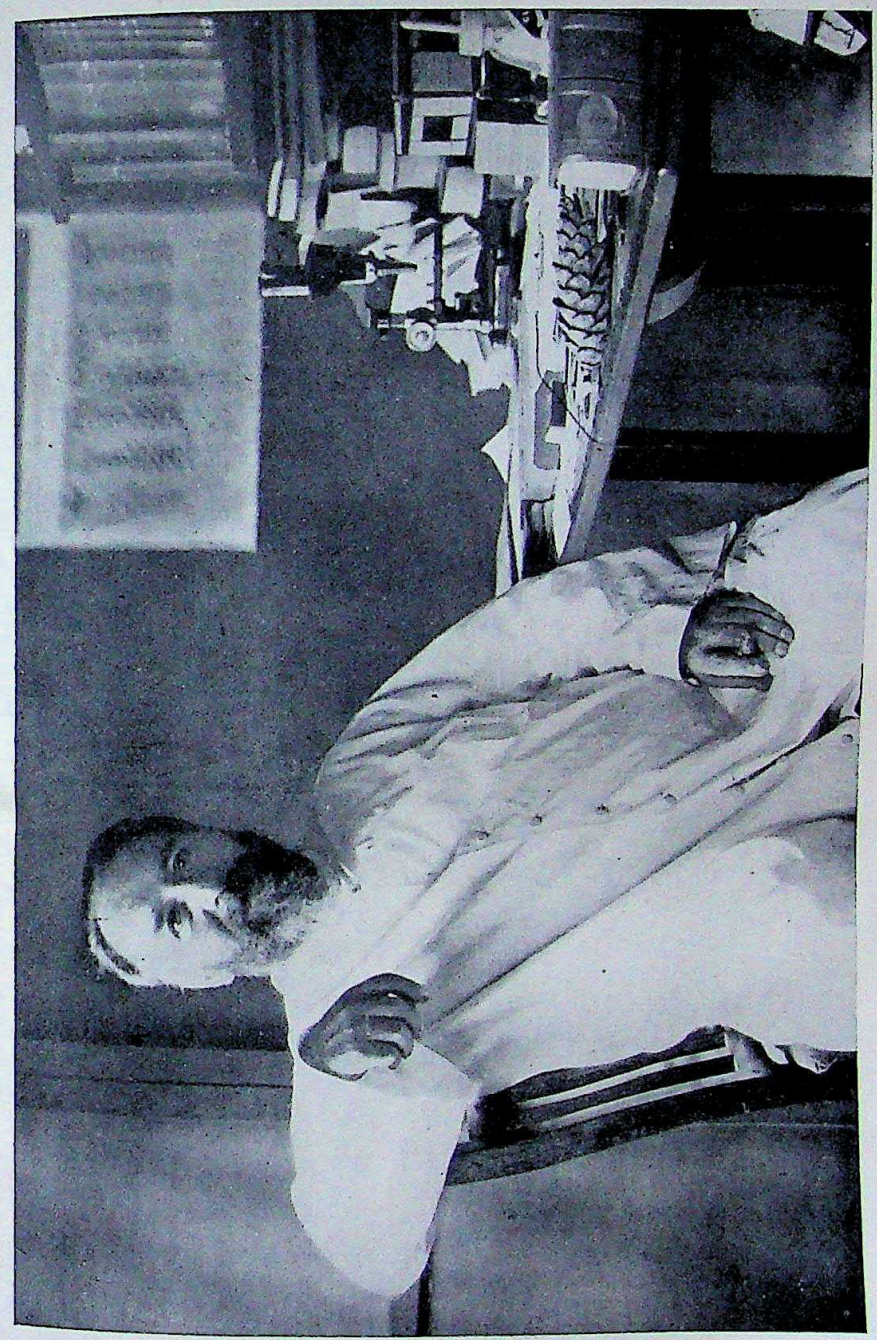

ETHELBERT BLATTER, S.J.

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near the snug town of the Dutch Limburg. In 1903, during the interval between philosophy and theology Blatter came to India for the first time. A companion writes: "Probably in quiet Holland he had chosen botany as his 'hobby'; but he would have been equipped for anything else in positive science, not so for merely speculative learning. He always liked to poke fun at the deep thinkers, who never returned to the realities of creation." However, from Blatter's own words, his botanical instinct had its origin much farther back. He had studied the flora of his native hills in boyhood and could name almost all the local plants, not only by sight but by taste. He had also acquired a sound knowledge of zoology and geology; but realising that he could not do justice to the three subjects at the same time, he concentrated on botany. He joined St. Xavier's College as Professor of Biology.

As a scientist he had already been very active in Europe. Wherever there was an important scientific congress, Blatter was sure to be there, his command of several European languages always stood him in good stead. Blatter related with much amusement an incident at one of these learned gathering. Returning home late one night from a congress meeting in Brussels he was accosted in a back street by a fellow who became abusive. Soon the Appenzeller awoke, and Blatter felled the ruffian who rolled into the gutter like a log. Next morning in the papers he read to his horror that in the night a man had been kiled in the street. Out went Blatter to see where he had knocked down his man. To his great relief he found that the reported fatality had occurred in another part of the town and that he was not 'wanted'. It was never advisable to fool with Blatter neither with the Swiss nor with the Jesuit.

Soon after his arrival in India, Blatter joined the Bombay Natural History Society. He was elected a member on the 19th January, 1904, and began soon after to contribute important scientific articles to the pages of the Society's *Journal*. His first article was entitled *The Fauna and Flora of our Metalic Money* (1). This was followed by others in quick succession. A list of his numerous publications on Indian and Asiatic Botany appears at the end of this obituary. During his stay in India he travelled much to different parts of the country, and made collections which formed the basis of all his writings. His most important contribution between 1904-1909 was a series of articles which appeared under the title of *The Palms of British India and Ceylon, Indigenous and Introduced* (17). This was subsequently published in book form by the Oxford University Press (29).

In 1909 Blatter returned to Europe to complete his ecclesiastical studies. By this time he had acquired that remarkable knowledge of the flora of India which was to help him considerably later on, and was to stamp him as one of the greatest systematists in the Indian field. Moreover, he had gathered around him a wide circle of friends who were sorry to lose him, and whom he was loath to quit.

From Bombay Blatter went to Hastings where the exiled Jesuits of two French Provinces had opened a house of theology.

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During the early days of the war—when many of the English Jesuits joined up as Military Chaplains, Blatter had to resume his priestly duties. He was for some time chaplain to the Dowager Duchess of Sussex. Blatter used to relate with loud laughter how the noble lady was wont to apportion him a single slice of meat which she carved in truly ducal manner from the daily shoulder of mutton. She considered this ample fare for an obviously over nurtured Jesuit. Unable to agree with her judgement of his capacity as a good trencherman, Blatter, unknown to the Duchess, was compelled to go to the local inn to supplement Her Grace's ration with more generous, if more plebian fare.

During this period of absence from India Blatter was a frequent visitor at Kew, where he spent much time compiling the *Flora of Aden* (23). At Kew he made numerous friends among the staff of the Herbarium, and they were to prove very helpful to him after his return to India.

Blatter was ordained priest on the 25th August, 1912, after which he spent another year in Holland and there for the first time felt that his health was no longer good. Before leaving a second time for India he went for special studies to London and compiled the *Flora Arabica* (28). He was in London when the Great War began. Hearing of the difficult position of the Bombay Mission, he secured a passage on a Japanese boat, passed through the Suez Canal through Turkish rifle fire and eventually landed in Bombay in October 1915. He had undertaken the second journey contrary to medical advice, but he knew that his superiors wished him to help the much tried Mission, especially St. Xavier's College. More than once, before and after that, Fr. Blatter had occasion to show his spirit of religious obedience; however much he might detest to be bothered with trifles, he knew his duty and never flinched.

On his return to Bombay he once more took up the Professorship of Biology at St. Xavier's College. He built up extensive collections, chiefly of botanical material, and thanks to him, St. Xavier's College is now the proud possessor of one of the finest herbaria in Western India. He travelled extensively in different parts of the country. In 1916 he was elected a member of the executive committee of the Society. In 1919 he was appointed Principal of the College, but though this honour hampered his botanical activities to a great extent, he nevertheless remained in his professorial chair till 1924. He was also a prominent member of the Bombay University Senate, and as such he had much to do with the present University Reforms. In 1925 he retired to Panchgani as Parish Priest, and this gave him ample opportunity to pursue his botanical studies. In 1930 while on an expedition in Waziristan he had a bad fall from his horse which resulted in a slight concussion of the brain and brought on partial paralysis. From this time though he still carried on with his botanical studies his health began to fail. In 1926 Fr. Blatter was elected a Vice-President of the Society. He was also on the Society's Advisory Board, and his sound advice and forceful arguments always carried much weight. In his death the Society has lost one of its ablest members and advisers, and India loses a great man who has done much for the

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country of his adoption. He was loved by members of every community, and large is the circle of friends and admirers who mourn his loss.

In recognition of his botanical work Fr. Blatter received the Johannes Bruehl Memorial Medal for the year 1931. The announcement was made at the Annual Meeting of the Asiatic Society of Bengal held on Monday, 1st February, 1932. The award was made in recognition of his 'Conspicuous Important contributions to the knowledge of Asiatic Botany'. Fr. Blatter was the first to receive this medal. He much appreciated this recognition of his efforts, and was really proud of it, as it was the only acknowledgement he ever received for the vast amount of work he had done for India. Strange to say honours did not come his way and, in the words of one of his friends, 'the familiar of three Governors, the eminent botanist, the educationist of no mean standing died plain Father Blatter'. Fr. Blatter's death ends the long line of the Blatter family as he was the only son and only survivor.

None who knew him will forget this loveable man. Under an ever joyous and ever ebullient surface there lay a deep, sensitive, almost melancholy soul, full of sympathy with the sufferings and hardships of others, ready to help even with imprudent liberality. Young and old, great and small, came to him and were the better for it.

Simple of heart he loved children. They flocked around him and clambered about him unafraid. About Xmas he would acquire a pile of children's annuals and gift books, and derive as much pleasure in the reading of them as did the little friends to whom he gave them. Nothing, not his successes nor his disappointments could suppress the boy in him.

Those who were unable to understand the man shook their solemn heads when he appeared to strain the limits of their narrower decorum. Then he was perfectly capable of going yet further purposely to shock the stiff guardians of the literal law. Thus he acted as a boy, thus he continued as a man. He cared nothing for mere disciplinarians. But he died as he lived faithful to the spirit of religious obedience and to the high traditions of his priestly order. His was a great heart. Of Blatter one might truly say:—

"His life was gentle; and the elements
So mix'd in him, that Nature might stand up,
And say to all the world, *'This was a man!'*"

The Office of the Society was closed for half the day on Monday the 28th May as a mark of respect for its late Vice-President.

C. McC.

List of Scientific Publications.

Blatter, E.:—

1. The Fauna and Flora of our Metalic Money. *Journ., Bom. Nat. Hist. Soc.*, xvi (1905), 334-339.
2. The Mangrove of the Bombay Presidency and its Biology. *Ibid.*, xvi (1905), 644-656.

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ERNST JOHANN OTTO HARTERT.

Through the death of Dr. Ernst Hartert on November 11, 1933, Ornithological Science has lost one of the most outstanding systematic workers in the last fifty years. Born on October 29, 1859 at Hamburg, where his father a Major in the Hanseatic contingent was then living, young Hartert from his earliest age showed a great taste for Natural History. As a schoolboy he began forming a collection of eggs which he greatly added to while a student at Konigsberg.

When twenty-five years old he was attached as volunteer zoologist to an expedition sent out to explore the Niger and Benue basins in West Africa and after a year and 4 months' absence returned to Germany *via* Sierra Leone. In 1887 he undertook a second expedition and this time went to the East Indies to collect beetles and butterflies. Most of his collecting was done in Sumatra and returning from thence to Penang he met William Doherty, the American collector, and arranged with him to go to Tibet. Owing, however, to troubles in Sikkim the collectors were unable to reach Tibet and instead went to Assam and the Naga Hills, hoping to penetrate into the Mishmi country, but were prevented from doing so by the authorities. The principal aim of this journey was to collect insects, but Hartert paid considerable attention to birds and published some interesting notes on the species met with in the *Journal für Ornithologie* for 1889. On his return to Germany he undertook the preparation of a catalogue of the birds in the Senckenbery Museum which was published in 1891. In the same year he married and came to London at the invitation of Dr. Günther to write the Swifts and Goatsuckers in vol. xvi of the Catalogue of Birds in the British Museum. When he had completed that work he was commissioned by Lord Rothschild and Count Berlepsch to make a collection of birds and lepidoptera in Venezuela and sailed for that country, accompanied by Mrs. Hartert, in 1892. Owing to a revolution in Venezuela he was unable to collect there and instead went to the Dutch West Indian Islands of Curacao, Aruba and Bonaire where he made valuable collections of which he gave an account of the birds in the *Ibis* for 1893.

Returning to England in the Autumn of 1892, he was appointed by Lord Rothschild to take charge of the Zoological Museum at Tring, which post he held till his retirement in 1930. During his long curatorship at Tring, Dr. Hartert assisted Lord Rothschild to build up the magnificent collection that Museum has long been famous for. As new collections were received they were reported on by Dr. Hartert in the Tring Museum Journal, *Noviatcs Zoologicae*, and from 1894 till his retirement a steady stream of papers appeared from his pen. In spite of the enormous number of specimens received yearly at Tring, Dr. Hartert kept the collection in perfect order and had an extraordinary knowledge of the specimens under his care.

He was greatly interested in the birds of the East Indian Islands and New Guinea, but it was the great Palaearctic region in which his chief interest lay and it will be by his book on the birds of that region that he will be principally remembered.

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After the Pastor Brehm collection had been acquired, Lord Rothschild, with Dr. Hartert's assistance, started to bring together the unique collection of Palaearctic birds at Tring on which the latter's well known book *Die Vögel der paläarktischen Fauna* was based. The first part was published in November 1903 and was completed in 1923 with a supplement in 1923. Two parts of a further revision were published, in conjunction with Professor Steinbacher after his retirement, a third appearing a short time after his death.

While this work was in progress Hartert made several trips to Europe to collect additional material and, accompanied by Lord Rothschild and at other times alone, he made some ten trips to North Africa, exploring the Avifauna from Morocco to Cyrenaica.

Although trinomials had been recognised in England before Hartert came to Tring it may be said that he was mainly responsible for the introduction of subspecies and the study of geographical races, which he did in the face of much opposition from the older ornithologists. But though the controversy was often rather bitter, Dr. Hartert never allowed it to affect his personal relationships with his fellow ornithologists. By the continual advocacy of his views he gradually convinced the younger ornithologists of the value of trinomials for denoting geographical races and by the time the first part of the Handbook of British Birds was published, all opposition had died down.

Hartert was keenly interested in other branches of Natural History, and had made a special study of beetles of the genus *Carabus*. He was a very careful and painstaking collector and had a wonderful knowledge of the birds of the world and the literature concerning them, which was always at the disposal of others. After his retirement we greatly missed his monthly visits to the British Museum, when the latest ornithological news was discussed and specimens from Tring compared with others in the British Museum.

N. B. K.

FRANCIS JAMES MITCHELL.

Frank Mitchell (as he was better known among his friends) was born at Saucheri, Ayrshire, Scotland. He was educated at the Madras College, St. Andrew's and in 1873 at the age of 18, came out to India to join his brothers in a contracting and brokering business at Cawnpore. Then followed years of strenuous effort, among them the period of the great famine, when Mitchell was instrumental in supplying quantities of wheat to the Government for the relief of distress. Always a pioneer, ready to grapple with fresh enterprise, he conceived the idea of exporting wheat from India—a successful trial shipment to England resulted in the opening up of the export trade of Indian wheat.

Other important works of lasting benefit to the country in which Frank Mitchell was concerned with his brothers was the building of the Bengal-Nagpur Railway and the construction of the Jhelum Valley Road from Khola to Srinagar.

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Subsequently Frank founded a brokering business in Bombay under the name of Mitchell & Co. About 1890 he retired from India a fairly wealthy man. Speculation in S. Africa practically ruined him. A friend relates that Mitchell was shooting in Scotland when he received a wire to say that he was "broke". Mitchell shot his best that day and topped the bag and returned to London, financially ruined but not in spirit. When hearing of men in financial distress committing suicide he would say 'I know what it is like, something hits you hard in the middle and it's the very devil to face the future'. Undaunted by his losses, Mitchell came out to India again in 1900, accepting a job in his brother's carpet factory at Srinagar on a salary of Rs. 200. The business was in low water, but Frank devoted his talents and energy to it. He travelled in Persia, Turkey and other countries, studying the methods of using vegetable dyes and finally succeeded in exhibiting his carpets at European exhibitions, and opening up a wider market for the Kashmir product.

Later he interested himself in olive culture in Kashmir and the Punjab. While studying on behalf of the Government the possibilities of olive growing in the Punjab and establishing an olive plantation at Kahire Murat near Rawal Pindi he also investigated the possibilities of working petroleum oil. His energies in this direction brought about, with the help of Sir Louis Dane, then Lt.-Governor of the Punjab, the formation of the Attock Oil Company Ltd. which he successfully floated in London just before the outbreak of the war.

In 1920, Frank Mitchell took over 700 acres in the Lower Bara Doab Canal Colony, Montgomerry District, and started the plantation of over 400 acres of fruit now known as the Indian Mildura Fruit Farm Ltd.—one of the largest fruit farms in India. His work in this connection has done much for the development of fruit culture in the Punjab and has been of benefit to the Province.

His leisure hours in Kashmir were spent in various hobbies, such as pheasant rearing and fish culture. He, it was, who conceived the idea of introducing Trout into Kashmir and he helped to found the Kashmir Trout Fishing Club. The excellent sport now available to Fly fishers in the State is due mainly to his unremitting effort. On behalf of this Club he undertook to obtain Trout ova while on a visit to England. This success was made possible by the assistance given him by the Duke of Bedford who arranged for supplies from his Devonshire estate near Tavistock. The first consignment of ova was not very successful, but Mitchell tried again. He met the second consignment at Bombay and personally looked after its transport to Kashmir. The ova eventually hatched out at Harwan and the Dochigan river was stocked. Hatcheries established by him at Harwan and Achibal have supplied the stock for most of the Kashmir rivers and lakes. Mitchell trained the local men in trout culture and taught them the work from spawning to distribution of yearlings. His story of how Trout were introduced into Kashmir was published in the *Journal* (vol. xxxvi, p. 295).

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Mitchell was an old valued member of the Society. He published various notes in the *Journal* mainly dealing with fish and fish culture but it was always difficult to induce him to write. One of the many things which he did for Kashmir which he so loved was to arrange with his friend, the late Fr. Blatter, for the publication of a work on the Beautiful Flowers of Kashmir which Mitchell financed. Two volumes have been published and the third was being considered; but death has now removed both the author and the inspirer of this fine work.

A genial loveable man, Frank Mitchell endeared himself to all with whom he came in contact. He was always a welcome visitor to the Society's office, never failing to come in when passing through Bombay. In spite of his age he was ever active, ever planning fresh projects and actively developing the enterprises he had in hand. He was happy in his many activities to the very end. He died at Baramulla, Kashmir on 20th November, 1933. He served India well and his loss will be regretted not only by his many friends but also by many a humble peasant. For besides his many abilities he had just those qualities which endear the best type of Englishman to the Indian villager.

HEUGH S. SYMONS.

An Appreciation.

By a Contemporary of His Son.

A large circle of friends outside Devon and Cornwall will hear with deep regret of the death of Heugh Symons, of Hatt. The knowledge that he died after but a few days' illness, as he would himself have wished, and that he was well and active up to and after his eightieth birthday, will be some slight consolation.

It is not my intention to write of his life at Hatt, the home of his childhood which, after various vicissitudes, he bought back in 1903 and where he retired to live when he finally came home from Bombay in 1914. It was undoubtedly a cherished hope of his that he would in due time be succeeded at Hatt by his only son, Hubert. Fate decreed otherwise, for Hubert was killed in March, 1918, commanding his battery in France, and his father never, I think, quite got over his loss.

Rather would I recall some of the old days in Bombay—days of which he was never tired of talking. There was plenty to talk about, for during his thirty-eight years in India, all but the earliest of which were spent in Bombay, he filled every moment he could spare from his business with some form of sport. His business he did not talk about; on his sporting experiences it was quite easy to get him started. Polo he did not play, partly because of his weight, but principally, I think, because he preferred to get out into the jungle and find his recreation there.

When speaking of pig-sticking, he was wont to belittle his own performances and to aver that he was not in the same class as his brothers, Nick and Jack. Possibly he was correct in his estimate. The two elder brothers that he so admired were amongst

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the *elite* of the pig-sticking world on the Bombay side in the eighties, having each won several Bheema Cups and also being credited with one Guzerat Cup each. In fact, in 1886 Nick only won the latter trophy after dead-heating with his brother Jack in the final and having to run it off. Surely a family record in the pig-sticking world! Nick also held the distinction of being one of the few men who are known to have ridden down and killed a full-grown wolf single-handed. The head of that wolf is at Hatt now.

A man might well not be in the same class as these two giants and still be considered a good man to pig. Mention of his brothers reminds one that Heugh, a modest man if ever there was one, was somewhat inclined to boast about one fact. That fact was that the four brothers, the fourth being General Pen Symons, killed in South Africa, had only five eyes between them. The soldier was the only one that had the full allowance. Each of the other three, Heugh from infancy, the other two owing to accidents with gun or spear, had only one apiece!

Riding to hounds with the Bombay or Poona and Kirkee, Heugh was, even when well on in years, most emphatically a 'bad 'un to beat'. Always well mounted and thoroughly appreciating a good horse, he yet did not hunt to ride. He loved watching hounds and observing the various signs of wild life that were to be seen on those early morning hunts by those who knew how to use their eyes. He saw more out of one eye than the majority of people did out of two, and it was always a joy to hear him describe a day's hunting.

Keen as he was on hunting, it was on shooting that his heart was most firmly set, especially during his later years out there. What he did not know about the snipe ground within reasonable distance of Bombay was literally not worth knowing. He was a noted shot in a land of good snipe shots, and on could be quite sure that if anybody got a good bag, Heugh Symons would get as good or better.

As a man, his popularity with seniors and juniors alike was firmly established on the sure foundation of his personality. Speaking as one of the juniors, I can testify to his sympathetic good fellowship. Always ready to join in a 'rag,' he was never so happy as when surrounded by a gang of cheerful youngsters, and they were just as happy to have him in their midst. One felt instinctively that if in a difficulty his help and advice would be generously given for the asking, and that they would never be forced upon one unasked. In that probably lay the secret of the bond between him and younger men.

One thing he could not abide was a slacker. Whether at work or play, he had always 'gone sixteen annas' himself and had no sympathy for anybody who did less.

To the end of his days he was an outstanding example of unbounded energy and of good sportsmanship in the best sense of that much abused term. The world is the poorer for his leaving it.

—(*The Gazette*, December 7, 1933).

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MISCELLANEOUS NOTES.

I.—THE INDIAN VAMPIRE (*MEGADERMA LYRA*) FEEDING ON A PIPISTREL.

It is well-established that the Indian Vampire Bat is carnivorous, feeding chiefly on small bats and birds, but I record the fact once more as I actually saw this bat capture a Pipistrel in flight. There are several records in the *Journal* dealing with the food of the Indian Vampire (see vol. xvii, pp. 835, 1021).

While sitting by the bedside of a sick man one evening, a Pipistrel entered the room at about eight o'clock, the light was on. It seemed to be in an awful hurry, circling round the room at 'full speed'. Shortly after it entered, in came an Indian Vampire Bat and immediately chased the Pipistrel. The chase lasted about a minute before the Vampire caught the smaller bat. The Vampire carried the Pipistrel about for a little while, but in trying to get out of the door it dropped its prey. It re-entered the room to recover the lost meal, but as I had risen from my seat it took fright and left altogether. This observation was made in Poona.

Bombay Natural History Society,
Bombay.

C. McCANN,
Asst. Curator.

January 25, 1934.

II.—AN UNUSUAL TIGER.

The northern part of the Jaipur State is composed of two districts called Shekhawati and Torawati, the first of which consists mainly of sandy desert, and the second of bare stony hills, and a less likely area in which to get tiger, it would seem hard to find. Nevertheless in the year 1931 from reports received from villagers of cattle being killed and people being mauled, it became evident that a tiger had taken up its home near a place called Buchara, on the borders of Khetri, an important Chiefship in the Jaipur State, and as the Superintendent of Khetri had kindly offered to pitch a camp there, I decided to make an effort to shoot it. His Highness the Maharaja not merely gave the required permission, but was good enough to lend the help of the State Shikar Department, some of the shikaris from which were sent on ahead to make the local arrangements. As soon as word came in from them that there had been a kill and the tiger had been located, I set out for Buchara accompanied by my wife, and was there met by the Superintendent and his wife, and the minor Raja of Khetri. We reached Buchara in the morning and rode out to see the reported kill. We found on arrival that there had been no less than five

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kills during the night all within a short distance of each other. The Shikaris were of opinion that there were two tigers, because of differences which they alleged to exist in the various pug marks in the loose sand that had been strewn round the kills. Although it is very unusual for a tiger to be so destructive, it seemed doubtful whether there was more than one tiger concerned, as the differences in the pug marks resembled those which would normally occur between the front and hind paws, and what happened subsequently suggests that this view was right. The country round Buchara consists of sand broken by rugged hills and is almost treeless. About a mile above the places where the tiger had killed there is a big embankment between two hills which impounds a lot of water during the rainy season, and the seepage channel for a mile or so below the embankment is marked by a dense growth of reeds about 6 ft. high, interspersed with occasional pools of water. This channel has fairly well-defined banks some 4 or 5 ft. high, and only at one place near the scene of the kills were there any trees, two small babul trees on the far bank. A machan had been prepared on one of these trees by the shikaris, but as our party was too large for one machan, we had a second one hurriedly constructed on the other babul tree. The Superintendent and I then rode back, intending to commence the beat after lunch. At 12-30 however word was brought that the tiger was on the move and so without waiting for lunch we proceeded to our machans. The beat began at a point some 500 or 600 yards distant on the other bank and was directed diagonally across the channel, as this was necessary to bring the tiger near the machans, and it looked as though the whole affair would be over in an hour at most. We had an army of coolies and 5 elephants; and a number of stops were also placed all round. Some avenues had been cut through the reeds, one of them right opposite the machans in order to make the tiger expose itself.

Shortly after the beat started the tiger was seen to cross one of the further avenues, and dive into the big block of reeds that came right up to our machan. We could occasionally see a slight movement of the reeds as the beat advanced, and eventually the tiger reached a point not more than 75 yards from the nearer machan, but without ever having exposed himself to view. As the beat closed in towards the machans, the beaters fell in behind the elephants, and it was just as well they did so, as the tiger then made three determined rushes on the elephants, upsetting their equilibrium badly. In spite of having been warned and the obvious danger, one or two Naga[1] beaters however advanced beyond the elephants and the tiger charged them, mauling one man rather badly. He would have been killed but for the fact that one of the other Nagas in the confusion fell on the top of the tiger so frightening it off. The beat was then stopped, and as it was clear the tiger was in a dangerous mood and unwilling to come forward, it was decided, in order to avoid any chance of further

[1] Curious semi-military ascetics peculiar to this part of Rajputana.

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accident, to burn it out. The reeds were very dry except round the occasional water pools and soon with the help of bundles of dried reeds an area of about 2 acres was burning fiercely. The tiger remained absolutely still all the while the reeds were burning, till the flames came right up to where he was lying, although the wind was carrying the smoke towards him and the heat even to us on the machan was almost insupportable. The tiger then suddenly broke back through a partial gap in the flames, scattered an elephant and some coolies who were advancing over the burnt out ground, and took refuge in a still smouldering but only partially burnt clump of reeds about 50 yds. further back. All this while, he was screened from the view of the machan by the flames and the smoke. The 5 elephants were then brought up in a close circle behind this clump and more burning reeds were thrown into it. At the last moment when it seemed that nothing would move the tiger, he made a sudden fierce rush across the narrow avenue that had been cleared opposite the machans at a distance from us of about 70 or 80 yds.

My wife had the first shot at it, and the Superintendent and I both fired, but although we thought the tiger had been hit by the first shot, we could not be certain of this. We then stopped the beat and the Superintendent and I, each on an elephant and keeping about 100 yds. apart went down the channel for some 200 or 300 yds. to get to the next open ground and had the reeds set fire to again. The heat where we were standing on our elephants was intense as the wind was blowing the smoke and the flames down on to us with the result that our elephants were most restive. Apparently the tiger, after coming down the channel towards us for some distance, broke back at an angle of 45° and showed itself for a brief moment in an open space, before diving into the only remaining unburned patch of reeds that was near. It was then clear that it had been hit, as he was moving rather slowly. Neither the Superintendent nor I had a chance of a shot, as we were facing in the wrong direction, but the shikari who was sitting on the elephant behind the Superintendent, had a snapshot which missed, as the elephant was swerving violently. We followed up the tiger taking up positions on opposite sides of the reeds and had them set fire to. Eventually when all but a small portion had been burned up, we moved in towards this, and the Superintendent coming upon the tiger lying with his head in a pool of water and obviously very sick, finished him off with 2 shots at close range. The shot which had first wounded the tiger had hit him in the breast rather low down and passed in and out between the ribs without breaking a bone.

On inspection the tiger proved to be a female, only 8 ft. 7 in. in size, but she had caused more trouble than any half a dozen ordinary tigers. For she kept us hard at work from 1 to 6 p.m. in the heat of a hot-weather day, severely injured one beater, frightened all the elephants and was only dislodged after several acres of reeds had been burned. I had always understood that wild animals dreaded fire, yet this tigress even when she was unwounded, lay quiet till the flames came right up to her, and

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broke back through the smouldering reeds rather than come out in front of the machans, which obviously she must have seen, as they were very low, and babul trees offer little cover. No other tiger was seen during the beat; although the whole area in which tigers could have lain hidden was gone over; so there is little doubt that this one tigress was responsible for all five kills the previous night, and was the same beast which had mauled several of the villagers, and destroyed numerous cattle.

THE RESIDENCY,
JAIPUR, RAJPUTANA. A. C. LOTHIAN.
February 14, 1934.

III.—DO FOXES OCCUR IN BURMA?

There is some mystery about the occurrence of the Fox in Burma.

The fox is of course known to the people of Burma—the 'earth-dog'—they call it—but during ten years I have spent in the country I have only seen a fox on one occasion. It was at Bhamo in 1925, when I was occupying one of the old officers' houses in the Cantonments, that one day I saw a Kachin approaching my house leading a fox on a chain!

I called him up into my verandah, and then examined the fox which was a full grown young one in excellent condition and as tame and as confidential as a dog. Two airedales I had at the time were present, and examined the fox with interest. The fox showed no fear of them at all.

It was a typical fox of darkish colouration not reddish and with a good coat and 'brush'. It was of ordinary fox size, and quite typical. At that time I was not aware of the rarity of such an animal in Burma or I would have taken possession of it. The Kachin wanted Rs. 60 for it. He at any rate was in no doubt about its rarity.

He had an extraordinary story to tell as to how he had caught it. He said a fox and two cubs attacked one of the village pigs and killed it, and that he killed the fox with a stick and caught this cub which he had since brought up.

There is doubt about the occurrence of the fox in Burma and my letter is intended to open up the question with this record of one.

Personally I am of the opinion that there are no foxes in this country—although one would have thought the Shan States ideal for them—and that this one recorded came from across the border from Yunnam.

TAUNGGYI, S.S.S.
BURMA.
T. R. LIVESEY.
February 14, 1934.

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IV.—A BISON SANATORIUM.

Namagundibetta (5,500 ft.) is a favourite haunt of bison on the Billigirirangans, but is chiefly remarkable for the fact that nearly every solitary bull shot in this hill has been found to be either injured or suffering from some disability. Out of ten solitaries shot there in recent years two were blind in one eye, three had been mauled by tiger, two were lame (one with a bullet wound and the other with foot and mouth disease), and another had a 6 in. piece of wooden stake imbedded in its chest and also a fly-blown ear. This bull had evidently impaled itself on a sharpened stake placed for deer (generally in a gap in a hedge bordering cultivation).

HONNAMETTI ESTATE,
ATTIKAN P.O., *Via* MYSORE, R. C. MORRIS.
S. INDIA.
March 22, 1934.

V.—'WHITE BISON'.

With reference to Dunbar Brander's comments on the colour of 'white' bison, while agreeing with him that the term 'white' is strictly a misnomer I consider it is no more so than in the case of the White Rhino of Africa, and as a distinctive term I do not think it can be bettered. Many similar cases exist of animal species being distinguished in works on Natural History by a definite colour term whereas they are not of the actual colour applied to them. If Mr. Dunbar Brander can say that the appearance of one or more of his light coloured bison among a herd of the normal type, even when seen from a considerable distance, is *startling* in its light shade, there is a possibility that we are both referring to a similar type. I may add that Mr. C. C. Wilson, Conservator of Forests, Madras, recently had occasion to visit the South Coimbatore 'white' bison area. He went there, as I did originally, somewhat sceptical as to the existence of bison of the type that had been described, and he describes the specimen he saw, among normal herds, as quite remarkable.

I cannot do better than quote from his letter to me on the subject:—"Dunbar Brander is wide off the mark on this occasion. I have seen very many herds of bison all over South India, in Malabar, Coimbatore, Vellore, Madura, Nilgiris etc., and I have seen very many light coloured individuals before, but never anything so unexpectedly 'white' as these are. In my opinion "white" is the most accurate description of these bison that we can get, and can leave no doubt in anybody's mind as to what to look for. If we call them 'dormouse coloured' (which they are not) many people will be misled and will be reporting that they have seen them all over the country whenever the not uncommon light coloured bison is found in a herd."

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Writing independently to a mutual friend Mr. Wilson describes the colour as a very light cream, and I agree with his description.

HONNAMETTI ESTATE,
ATTIKAN P.O., *Via* MYSORE,
S. INDIA.
January 18, 1934.

R. C. MORRIS.

VI.—GROWTH AND SHEDDING OF ANTLERS IN SAMBAR (*RUSA UNICOLOR*) AND CHEETAL (*AXIS AXIS*) IN SOUTH INDIA.

SAMBUR.

(A) Time of shedding antlers .	end March to mid-April.
(B) Period during which antlers are in velvet ...	end May to end October.
(C) Period when clean ...	end October to end March.
(D) Pairing season	middle to end November.
(E) Time when young are born	late May or early June.

I find that the above periods are liable to variations of a fortnight or so in different years; for instance I have known sambur to be in hard horn by the middle of October, and in this case the pairing season would also start a fortnight earlier.

CHITAL.

(A) Time of shedding antlers ...	majority in August-September.
(B) Period during which antlers are in velvet ...	majority in September-February.
(C) Period when clean ...	majority in March-July.
(D) Pairing season ...	majority in March-May.
(E) Time when young are born	majority in September-November.

As is well known, chital are mostly irregular in their antler shedding and rutting. Fawns may be seen at any time during the year, as also chital in velvet, but mature stags are fairly regular in their seasons except that the periods during which they shed their antlers, are in velvet, are clean, and are pairing, are longer in that these periods vary with individuals during those three months. I am now referring to mature animals only. There is no such regularity in the case of immature stags.

HONNAMETTI ESTATE,
ATTIKAN P.O., *Via* MYSORE,
S. INDIA.
February 4, 1934.

R. C. MORRIS.

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VII.—GROWTH AND SHEDDING OF ANTLERS IN THE SWAMP DEER (*RUCERVUS DUVAUCELLI*) IN THE UNITED PROVINCES.

(1) The antlers begin to drop from about February 15th, but there are still a good many stags carrying horns during March. By about April 15th, practically all stags are hornless.

(2) The new horns begin to grow in a few cases at about the end of March, but the main period for velvet horn is May to August, continuing in a few cases into September.

(3) Horns begin to harden in September and most are quite clean by Ocober 15th.

(4) The chief rutting season is November to December, when the peculiar rutting call of the stag (something like a donkey braying with a droning under-note) is frequently to be heard.

(5) Most of the young are said to be born from May to July, but I have not very much personal experience on this point.

The closed season for gond in the United Provinces is from March 15th to October 14th.

BAHRAICH DIVISION. F. W. CHAMPION,
February 9, 1934. I.F.S.
Divisional Forest Officer.

VIII.—NOTES ON THE SWAMP DEER (*RUCERVUS DUVAUCELLI*) IN ASSAM.

(1) *Assamese Name.*—Male: Batina-Sakal Jati. Female: Belingi.

(2) *Time of shedding of antlers.*—February to March.

(3) *Time when antlers are in velvet.*—New antlers begin to appear in April to May. The antlers remain in velvet till the end of July; and the dry skin falls off during August to September.

(4) *Period when antlers are clean.*—August to September to February to March.

(5) *Pairing season.*—April to May, when the *male is practically without antlers.*

(6) *Time when young are born.*—This varies with the age of the mother. In the case of females that are not past their prime the young may be delivered in December to January; while in the case of older females the young may be delayed in their appearance till as late as the end of February.

(7) *Habit.*—Prefers high land surrounded by water all round. Does not care much for leaves of plants. Prefers grasses and reeds; and stays where these abound. Feeds mostly in the early hours of the morning and at evening time. Also loves to feed on rice cultivation soon after nightfall. It is believed that the animal takes a short rest after midnight.

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(8) *Habitat.*—Exists in Goalpara, Kamrup, Nowgong, Sibanger and Danang Districts of Assam.

Common Hindustani name.—Barasingha.

North Kamrup,
Assam.
March 7, 1934.

C. A. R. BHADIAN, I.F.S.,
Asst. Conservator of Forests
in charge North Kamrup Sanctuary.

IX.—CLICKING SOUNDS MADE BY MUNTJAC.

I have often seen mentioned, both in the *Journal* and elsewhere, that the Barking Deer makes a peculiar clicking sound. I have kept a deer for nearly three years and it is very tame. It frequently makes such a noise, and does it by putting its tongue out against its big canine teeth, first on one side, then on the other. It invariably does this when it sees me eating something, such as toast, of which it is fond. Whether this is the sound others have heard I do not know, but it answers the description and is certainly made with the tongue.

Nowroj Gardens, Chetput,
Madras.
February 24, 1934.

S. SUNDARA RAJ.

X.—A LARGE PAIR OF ELEPHANT'S (*ELEPHAS MAXIMUS*) TUSKS FROM BURMA.

(*With a plate*).

I send herewith two photographs of a remarkable pair of elephant tusks which I saw recently at Lonhkin, in the house of Sinwa Nawng, Duwa of Kansi in the Kachin Hill Tracts of this district. These tusks are said to have been obtained from an elephant which was found dead about some eight years ago near Kansi village. This village is on the Uyu, a tributary of the Chindwin in the western part of this district. One photograph depicts a 5 ft. 6 in. Kachin standing between the tusks.

(2) The tusk (a) on the left-hand side of the photograph is 79½ in. long, and (b) on the right-hand side measures 77½ in. The girth of (a) near its base is 17 in. and that of (b) is 17¼ in. and at 5 in. from the tip, the girth of (b) is 10¼ in. These tusks are slightly larger than a very fine pair shot by Mr. H. E. Flint, O.B.E., in the Ruby Mines some years ago (which he has in Myitkyina and of which one is 79 in. and the other 69 in.). The Kansi tusks are extremely dark in colour. I did not get an opportunity to weigh them.

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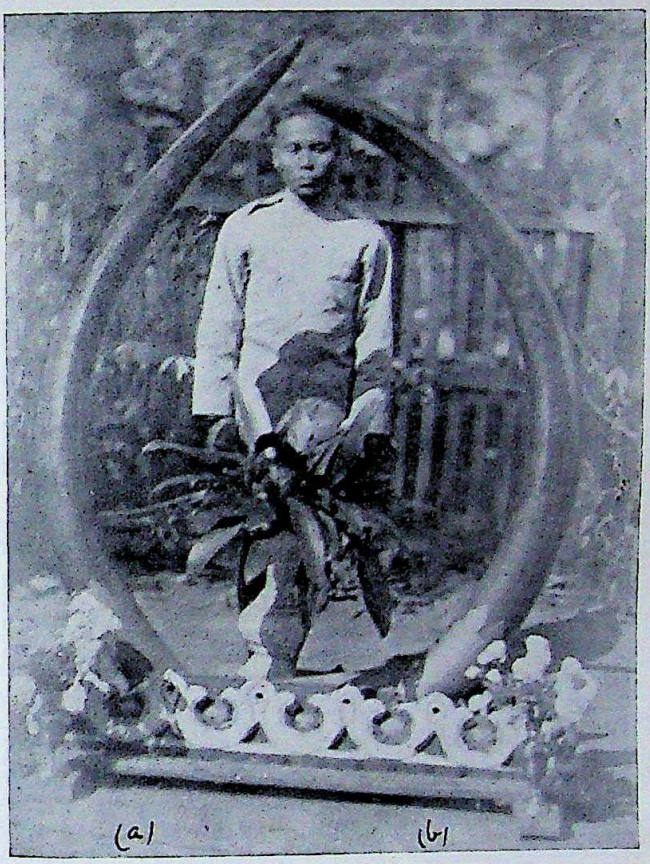

(*a*) 79½ in. length, 17 in. cir. near base.
(*b*) 77½ in. length, 17¼ in. cir. near base.
girth of (*b*) 5 in. from tip was 10¼ in.
The man is 5 ft. 6 in.

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(3) I hope that the photographs will be sufficiently clear for reproduction, as though not a record they must be among the biggest obtained in Burma.

MYITKYINA,

UPPER BURMA. J. K. STANFORD,

February 20, 1934. *Deputy Commissioner.*

[In Rowland Ward's Records of Big Game, 9th Ed. (1928) the largest tusks obtained in Burma (owner's measurements) are 10ft. 6 in. in length and owned by Mr. H. Shaw Dunn. The longest measured in the Rowland Ward Studio taped 7 ft. 3⅜ in. in length, 17½ in. in circumference and weighed 102 lbs.—EDS.].

XI.—STATISTICAL RECORD OF GROWTH IN THE INDIAN ELEPHANT (*E. MAXIMUS*).

The following notes may prove of interest. They have been compiled from a Register of Working Indian Elephants (1,507) and Calves (365) born in the service of a Firm extracting Teak in Burma.

1. No one has any reliable information regarding 'milk tusks' and none of our employees has seen them.

2. *Parentage and Sex.*—(*a*) A tusker calf shows its tusks from the age of 2 years to 5 years.

(*b*) Cases of calves with double tusks shedding one and so becoming 'tehs' are now authenticated.

(*c*) Tuskless male calves (Haings) are known to have tuskers as fathers. Tuskless males, as fathers, have reproduced double tusker calves.

Musth.—Reports by eyewitnesses prove that 'musth' in males was not present in the majority of cases of coition, and that the female has a periodical period of heat, which cannot usually be detected by the human being. A few cases have been recorded of females discharging from the musth gland, when apparently not on heat.

A tusker calf came on musth in his 15th year.

Reproduction.—A female calf, 15 years old, has produced her first calf. She must have been covered when just over 13 years old.

Height Increment.—Calves measured within three days of birth averaged 3 ft. 0 in. in height. 109 male and 111 female calves measured produced the following results in heights:—

In	1st	year	6	males	averaged	3′0″	8	females	averaged 3′0″
	2nd	,,	8	,,	,,	4′2″	5	,,	,, 3′11″
	3rd	,,	7	,,	,,	4′5″	...	,,	,, ...
	4th	,,	4	,,	,,	4′10″	3	,,	,, 4′6″
	5th	,,	4	,,	,,	5′6″	3	,,	,, 5′1″
	6th	,,	9	,,	,,	5 8″	10	,,	,, 5′5″
	7th	,,	11	,,	,,	5′10″	12	,,	,, 5′7″

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In 8th	year	8	males	averaged	5′11″	13	females	averaged	5′9″
9th	,,	9	,,	,,	6′1″	4	,,	,,	5′11″
10th	,,	7	,,	,,	6′5″	4	,,	,,	5′10″
11th	,,	6	,,	,,	6′9″	6	,,	,,	6′0″
12th	,,	6	,,	,,	6′10″	8	,,	,,	6′4″
13th	,,	7	,,	,,	6′11″	5	,,	,,	6′6″
14th	,,	6	,,	,,	7′2″	4	,,	,,	6′5″
15th	,,	4	,,	,,	6′11″	5	,,	,,	6′7″
16th	,,	2	,,	,,	6′11″	...			...
17th	,,	1	,,	,,	7′5″	3	,,	,,	6′6″
18th	,,	1	,,	,,	7′6″	3	,,	,,	6′7″
19th	,,	1	,,	,,	7′8″	4	,,	,,	6′8″
20th	,,	1	,,	,,	7′5″	1	,,	,,	7′6″
21st	,,	4	,,	,,	7′4″	1	,,	,,	6′8″
22nd	,,	1	,,	,,	7′3″	...			...
23rd	,,	2	,,	,,	7′5″	1	,,	,,	6′7″
24th	,,	...			...	1	,,	,,	6′8″
25th	,,	1	,,	,,	7′10″	1	,,	,,	7′0″
26th	,,	1	,,	,,	7′10″	...			...

An exceptional Tusker calf, not included in the above, measured 8 ft. 1 in. in his 19th year.

We do not consider these statistics perfectly accurate, for the margin of error during measurements has to be considered. Also far greater numbers of calf measurements are needed. As statistics progress, however, this margin of error will decrease.

STEEL BROTHERS & CO., LTD.,
RANGOON. GORDON HUNDLEY.

February 26, 1934.

XII.—ON THE OCCURRENCE OF THE WHITE-COLLARED KING-FISHER [*SAUROPATIS CHLORIS* (BODD).] IN THE DISTRICT OF 24-PERGANAS WITH A NOTE ON JUVENILE COLORATION.

The form *chloris* of the species *Sauropatis chloris* (Bodd.) has its range, according to Mr. Stuart Baker's record in *F.B.I.* (Birds), 2nd ed., vol. iv, 275, limited to the 'coasts of the North-Eastern Districts of Bengal; once Cachar in Assam; Burmese Coastal Districts, Siam, Malay States, Borneo, Java, Sumatra, Annam'. No mention is made of the Sunderbans, where Blyth found and collected his specimens (*Cat. B. Mus.* A.S.B., 48), and Blanford noted the occurrence of the bird as being as common throughout the eastern coast of the Bay of Bengal (*F.B.I.*, old ed., vol. iii, 136). It is difficult to see if the 'North-Eastern Districts of Bengal' may, by implication, have any reference at all to the Sunderbans. The Indian Museum holds a goodly number of skins (Nos. B517-21 and B529) of this form all collected from the Sunderbans. So far as Lower Bengal is concerned, not only do

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the Sunderbans afford the birds a congenial habitat but the inland parts as well, in many cases considerably away from the Sunderbans, harbour the race in not negligible numbers. Their occurrence in the immediate vicinity of Calcutta was noted by Cunningham who wrote (1903) 'another characteristically Sunderban species, *Sauropatis chloris*, may sometimes be seen about the ponds in the Botanic Garden'. Curiously enough there appears to be no other record of such occurrence. In my rambles in the District of 24-Perganas I have found them not uncommon in its north-eastern parts, and affecting the low-lying alluvial tracts known as *Churr* lands on the banks of the river Ichamati, a little beyond and to the east of Basirhat town (about 40 miles North-East of Calcutta). Chiefly arboreal as they are, they affect not only the date trees and shrubs growing on or near swamps and *Churr* lands but also orchards of neighbouring villages and even roadside trees. Fairly bold and noisy, they keep on the trail of fisher people when dragging nets and incessantly utter their shrill calls. They are easily captured with fish bait, fish being their tempting food. However local and circumscribed their habitat the birds are found in this area throughout the year. They nest in tree-holes, such nests being often found in orchards or fruit gardens adjoining the villagers' huts. Of the specimens obtained by me two young birds (fledglings, just out of nest) deserve mention. Their juvenile coloration being thus noted in my diary:

July 26, 1931. Two young *S. chloris* (Bodd.) out of nest, sitting on two different branches of a jack tree beside the road beyond Basirhat town to Itinda. Being fed on insects by both parents. Coronal plumes erectile,—a feature specially noticeable whenever agitated, with the tail moving and shaking.

Measurements:—

Reg. No. T1931. 5. Wing 99 mm.; tail 55 mm.; tarsus 18 mm.; culmen 36 mm.; gape 45 mm.

Reg. No. T1931. 6. Wing 100 mm.; tail 50 mm.; tarsus 17 mm.; culmen 38 mm.; gape 46 mm.

Coloration more pronounced: head and crown with more green; neck-collar white mixed with buff and tipped greenish black; barrings on breast brownish black; buff on flanks and vent prominent.

Description:—Forehead, crown and nape dull brownish-green contrasting with the bluish-green of the upper back; sides of head brighter green, feathers of forehead edged with rufous; lores black; a rufous-white patch above the lores extending over the eye; ear-coverts black, which is produced as a band behind the nape, the latter having an ill-defined patch of white tipped with brownish-green; below the black band is a broad collar of reddish-white tipped with bluish-green; lower back, rump and upper tail-coverts bright blue, rather inclined to purplish; scapulars and wing-coverts bluish-green tipped with rufous. Quills black on inner and greenish-blue on outer webs; two central tail feathers blue as lower back, the others blue on outer web and portion of inner web, the rest of the latter dark brown or black. Under-

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surface of quills and tail feathers glossy grey. Lower parts white; feathers of breast and flanks fulvous and edged with dusky, the latter appearing as crescentic bars of brown; abdomen, vent and undertail-coverts white, faintly tinged with buff; axillaries and underwing-coverts white, edged with silver grey, a few feathers tipped with greenish-blue.

Iris light brown; upper mandible and the edges of the lower dull black, with white and hooked extreme tips; basal two-thirds of the lower mandible light flesh-colour; inside of mouth red; legs plumbeous, inner surface of toes, and tarsus pale fleshy; claws blackish or dark horn.

CALCUTTA. S. C. LAW, M.A., PH.D.,
February 13, 1934. F.Z.S., M.B.O.U.

XIII.—NESTING HABITS OF THE BLUE-ROCK PIGEON (*COLUMBIA LIVIA*).

Will you, please, let me know if the following incident is unusual? My engineer, once saw two Blue-Rock pigeons drinking from the exhaust water of a steam engine—temperature of the water being 140° F.! I have found these birds living happily in very odd places: in the engine room where two coupled vertical triple expansion steam engines (developing a total of two thousand horsepower) are working day and night; over a battery of steam boilers where valves are hissing continuously—even the blowing off of live steam under a pressure of 200 lbs. does not disturb their equanimity. They not only reside in these places but even breed there!

AHMEDABAD. H. N. ACHARYA.
December 18, 1933.

[The Blue-Rock Pigeon, which is almost semi-domesticated in many parts of India has adapted itself to the varied conditions of life which its association with man imposes. It is not uncommon to see the nests of these birds in the engine rooms of mills, or in railway stations, where, in the roofing above the track, the nests and their occupants are exposed to heat, steam and smoke. Conditions which appear to cause them little inconvenience.—EDS.].

XIV.—OCCURRENCE OF THE MANDARIN DUCK [*AIX GALERICULATA* (LINN.)] IN THE MANIPUR STATE.

On the 3rd March, 1934, two Mandarin drakes and two Mandarin ducks were shot in Manipur State. As the bird has been recorded very rarely in India, I send a description of the shooting in case it may be of interest. Capt. W. L. Neal, I.M.S., and I were shooting down the Mayangkhang Valley at a height of about 3,500 ft. The valley is narrow varying from about 200 yds. to

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half a mile in width with hills on either side rising to 5,000 ft. or more. The Senapati stream runs through the valley joining the Barak river about 6 miles away. It is quite a small stream varying from about 12 to 25 ft. in width, with a stony bottom, and at this time of year about ankle-deep in most places. There are occasional pools and here and there old beds of the river with water and high grass in them.

Capt. Neal who was walking along the bed of the stream fired at 4 or 5 duck which rose from it. Two birds fell; but they were rather far away, and, although we searched for some time, we could find no trace of them. At this place the stream is right up against the hillside which was covered with thick grass and some trees. It was a shady spot and the water was perhaps a foot deep. In the shade the visibility was poor and we did not recognise that the birds were any unusual kind of duck. Common teal have been shot in that valley before.

About one mile further on one pair, a drake and a duck rose out of an old bed of the stream from thick high grass in front of me. I had just shot a bamboo partridge and was not loaded when the duck rose. It flew back and Capt. Neal shot it. The drake rose a moment later and flew back. I failed to bring it down. We still did not know what the birds were. The drake appeared to settle about a mile away up stream.

Later in the day Capt. Neal left and Mr. C. F. Jeffery, State Engineer, joined me. We returned along the stream and this time I shot the drake, which Mr. Jeffery identified. There seems to be no possible doubt about the identification. I have sent you the skin of one drake and one duck to verify.

When we went to the place where Capt. Neal had first fired, Mr. Jeffery's Labrador bitch found both the wounded birds in the long grass on the hillside. We had previously decided that, if they could fly, we should not shoot; but both had been hard hit and we could not leave them.

IMPHAL,
MANIPUR STATE, C. GIMSON.
ASSAM.
March 28, 1934.

[The birds sent in for identification were Mandarin Ducks (*A. galericulata*). According to Stuart Baker, *New Fauna*, the Mandarin has so far only been obtained at Lakhimpur, Assam, by Stevens. Six birds were once seen by the author.—EDS.].

XV.—MIGRATION AND DECREASE OF SNIPE IN THE ANDAMANS.

I was very pleased to read in vol. xxxvi, No. 4, *B.N.H.S. Journal*, Major A. Bayley-de-Castro's reply to my letter on early snipe in the Andamans. I too have found odd birds very late in the year but I seldom shoot them as I find them usually

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quite unfit to eat. I consider that it is quite possible that some snipe do permanently remain in the Andamans.

Major Bayley-de-Castro's letter has also touched on another matter in which I am greatly interested—the migration of snipe. Unless 1932 and 1933 were exceptionally bad years for migratory snipe the number of birds which visit the Andamans is steadily decreasing. Recently I was speaking to a retired Indian Officer of the Military Police Battalion who has spent more than 30 years in the Andamans and he assured me that this was the case. This year out of 23 days I had 7 days shooting with an officer who is a good average shot. On no occasion, if we had shot brilliantly, could we have killed 25 couple of snipe and our best bag was actually 18 couple. When we did find birds in any quantity, and that was chiefly on the hillsides, they were extremely wild and got up in wisps. There was a minor cyclone in the middle of November and on November 19th, after the wind had dropped I went out alone and picked up 16½ couple of snipe which was my best bag this season. In the Settlement Mess Game book there is an entry to the effect that one gun shooting alone in 1928 killed 1,000 snipe before Christmas. Since then the book, although it has not been too carefully kept, clearly shows that there have been a series of very lean years. Last year I personally accounted for 105½ couple of snipe and this year for 118½ couple. I have one more year to serve in the Andamans and I hope that it will produce a really good snipe season but I am afraid that the days of big bags are past, although the birds are not harried by overshooting, another officer and myself being the only two regular guns.

PORT BLAIR,
ANDAMAN ISLANDS.
January 31, 1934.

J. MILES STAPYLTON, I.C.S.,
Deputy Commissioner.
Andaman and Nicobar Islands.

XVI.—OBSERVATION ON THE NEST OF THE DABCHICK [*PODICEPS RUFICOLLIS* VROEG]

I am indebted for much help in recording these observations to Master Kannan, the young son of Dr. M. Ramaswami Nayudu, PH.D. (Liverpool), who kept careful watch over the nest and bird. His first experiment was to hatch one of the dabchick's eggs under a hen, thinking he would get a young one to study at his convenience, but the hen, wondering what sort of strange creature had got into her nest, ate it up directly it emerged from the egg!

The nest was built on the top of a bush near the bank of a pond in Madras City. It was not more than two inches above the water level and took the form of a shallow saucer-like hollow 12.25 cm. in diameter, consisting of a soft padding of weeds, chiefly *Elodia*. Two eggs were in the nest when I saw it. They were whitish when laid, but by that time had become dark brown with mud and water. The two eggs measured 36 and 36.5 mm. in

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length and 25 mm. in breadth. Four eggs were laid, according to Kannan's diary, as follows—one each on the 25th, 27th, 29th and 30th December.

On Saturday, 3rd March, at about 4 p.m. on Malad-Merve beach near Bombay, at 2-20 p.m. two chicks were brought to me and I kept them for a few days, putting them into a box at night with a lamp and in the day time into an improvised nest of weeds in a large vessel of water. From the moment of birth they were able to swim and dive. Feeding was difficult but they learnt to take minute scraps of fish from a pair of tweezers. They were coloured characteristically with black and buffy stripes, but in addition had a beautiful coral red beak. This red colour quite disappeared by the third day. After keeping them for three days one died, and I returned the other to the nest. In the meantime the third egg hatched and, four days after the first, the fourth and last egg hatched. After that the hen abandoned the old nest and took the young ones to the weeds in an inaccessible part of the pond.

The bird covered her eggs very carefully every time she left the nest. At the slightest alarm she would hastily throw some weed over the eggs and dive into the water, to emerge some distance from the nest. When all was quiet she would return by a circuitous route, uncover the eggs and sit again. The nest was soaking wet.

At the time of writing—February 21st—there seemed to be only one young one left with the mother bird, which she was intent on teaching to fend for itself. At least it got a sharp peck if it came too near.

Stuart Baker gives January and December and again in June as the period of nidification in Ceylon, and May and June as the usual time in South India. It appears from this however that nesting goes on at the same time in Madras as in Ceylon.

Nowroj Gardens,
Chetput,
Madras.
February 24, 1934.

P. S. SUNDARA RAJ,
(Mrs.)

XVII.—A LARGE MUGGER (*CROCODILUS PALUSTRIS* LESSON) FROM BIKANER.

The Heir-Apparent of Bikaner has just shot a very fine mugger proper, not gharial, which measured 11 ft. 0 in. exactly from nose to tip of tail. I give below some measurements:

	ft.	in.
Skull just above the eyes ...	3	2½
Girth of neck ...	3	11
Girth of largest portion of body ...	4	6

As this appears to be a very fine specimen indeed, the Prince would be grateful by your kindly letting me know how it compares

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with some of the largest muggers shot in India and what the record length is.

THE SECRETARY TO THE
HEIR-APPARENT OF BIKANER.

BIKANER.
February 10, 1934.

[In the second edition of the Fauna British India (Reptilia) the Mugger (*C. palustris*) is said to attain a total length of 4 metres (approximately 13 ft. 2 in.). The Estuary Crocodile (*C. porosus*) is said to attain a length of 33 ft. but individuals exceeding 20 ft. are rare. We should be glad to receive from readers of the *Journal*, measurements of large mugger which they may have occasion to take.—EDS.].

XVIII.—NOTE ON THE LOGGERHEAD TURTLE [*CARETTA C. OLIVACEA* (ESCHSCHOLTZ)] DEPOSITING ITS EGGS.

(*With a plate*).

On Saturday, 3rd March, at about 4 p.m. on Malad-Merve beach, I was idly watching the sea when a curious upheaval, which subsequently resolved itself into something which looked like the Loch Ness monster, showed up near the edge of the water, and proceeded to steadily move towards the shore. I walked down to have a look and saw a large turtle emerge. The turtle crawled laboriously from the edge of the sea up to about 6 ft. above the high water mark at the foot of the sand dunes. Her progress was slow and she frequently stopped and held her head in the air swallowing vigorously. On arrival at the foot of the sand dunes, she immediately set to work to dig a hole with powerful alternate strokes from her hind flippers, holding herself rigidly in position by her fore flippers. She gradually deepened the hole until she had got quite a respectable excavation about a foot wide and 18 or 19 inches deep. Towards the last, it was curious to see the tremendous efforts she made to get her back flippers down to the maximum extent possible into the hole in order to dig it as deep as possible.

The two photographs show her clearly

(*a*) at the point where she is flipping out the sand with her body in a horizontal position,

(*b*) straining to get her back flippers down into the hole to the maximum extent.

By this time, quite a large crowd of villagers and others had gathered around her. She took not the slightest notice of anybody, but continued to dig. She then settled down flat on the top of the hole. One of the villagers started digging a deeper hole behind the egg-chamber and tunnelled through to it. As her eggs dropped, they rolled through the tunnel and he removed them. In all she laid 122 eggs about the size of ping-pong balls, with a tough skin of a whitish-blue hue.

The whole process of laying took about 12 minutes. The villager then quickly covered up his hole so as not to disturb her.

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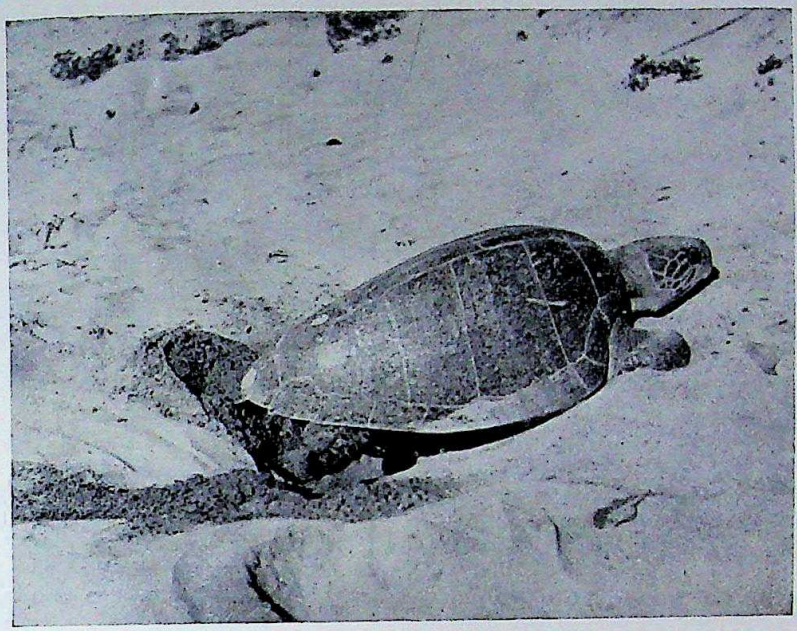
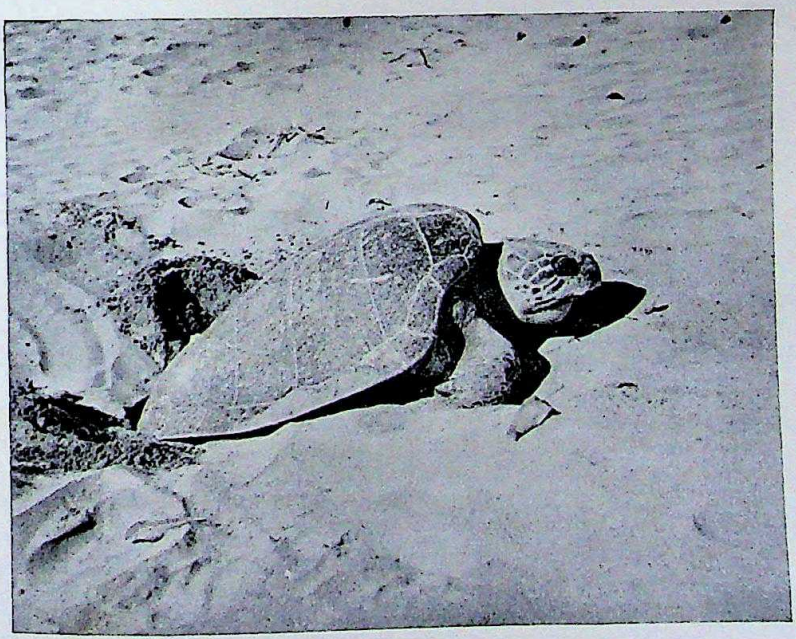


1. Loggerhead Turtle [*Caretta c. olivacea* (Eschscholtz)] commencing to scoop a hole in the sand before depositing eggs.



2. Loggerhead Turtle (*C. c. olivacea*) deepening the hole in the sand to its maximum depth.

Photos by J. B. Greaves.

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and she, oblivious of the fact that all her eggs had gone, proceeded to rotate round and round, smoothing the sand, as she thought, over her eggs.

When the hole was quite filled up, she started off back to the sea with the same laborious slow process, with frequent pauses and gulpings for breath.

As soon as she entered the water, her speed increased, and it was as much as one could do to keep pace with her wading quite fast. She went straight out through quite heavy surf until she was no longer visible.

The whole proceeding took about two hours from when she emerged from the sea to when she returned to it.

FORBES STREET,
BOMBAY. J. B. GREAVES.
March 15, 1934.

XIX.—THE LARVA OF THE LOBSTER MOTH (*STAUROPUS DENTILINEA* HAMPSON).

(*With a plate*).

Of all known larvae, surely that of *Stauropus* or the Lobster Moth is the most bizarre. The moth is more commonly come across than the larva but neither are common; the latter from its cryptic colouring and stance is most difficult to see even to the trained eye and because few collectors have had the good fortune to come across it, the following short note will be of interest.

Stauropus fagi Linn., the genotype is found throughout Europe and England and was considered a prize even in my young days. Five species have been described from within Indian limits of which three are confined to the Himalayas, one to the Nilgiris and a fifth to a much wider area extending from Assam to Burma, Ceylon and Java. The latter probably includes several distinct races. The larvae of the genotype, of *Stauropus alternus* and *sikkimensis* alone are known, that of *dentilinea* hitherto being unknown.

The latter closely resembles that of the genotype and of *S. alternus* in its colouring, there is however only a single subdorsal oblique stripe which is of pure dazzling white and confined to the 6th somite. Laterally two pale purplish white arches are found, one extending from the 4th to the 7th somite and the other confined to the 9th and 10th somites. The ground colouring is of a rich mahoghany tint with diffuse brighter ferruginous patches on the sides. There is also a dark brownish streak on each side of the head. Paired dorsal processes are found on the 4th to the 9th somites instead of on only the 6th to 8th, and there are also two unpaired processes on the terminal somite. The sides of the latter are expanded broadly and the preceding somite has three fleshy spines on each side. The legs show the same extraordinary development characteristic of the genotype (Fig. e) and are minutely spined throughout. Hampson states that the anal prolegs are

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absent but this is an error, as the two angular processes attached to the anal somite, are in reality extraordinarily developed prolegs, as in the case of the 2nd and 3rd pairs of true legs. In some specimens these are absent having been lost from autotomy or eaten off by other larvae, a not uncommon accident when several larvae are kept together in captivity. When at rest, the larva rests on its prolegs which are stretched out like a suspension bridge, the head and anterior somites being curved strongly over the dorsum of the insect so as to meet the expanded anal somite which is also held strongly curved forwards over the dorsum. The anal prolegs are held in close apposition except when the insect is moving or feeding when they diverge strongly, apparently to allow of the free passage of frass from the anal orifice situated just above them. During rest the tarsi are constantly flexed and extended, a peculiar action which strongly reminded the writer of the action of cilia in a vorticella. The purport of this action was not at all clear. When at rest also the true legs are held straight out in front very like a praying-mantis, the 2nd and 3rd pairs of tibiae being closely apposed to the femora. As a rule the larvae pose on the edge of a leaf and look for all the world like a piece of dried crumbled or curled leaf. It was interesting to note that dried broken leaf on the food plant was of exactly the same bright mahoghany colour, so that the detection of the larvae was extremely difficult. When moving, the head is held well back, flexed over the dorsum of the anterior segment except when actually feeding, and the terminal somite is invariably carried aloft. In spite of its remarkably cryptic appearance, this larva falls a frequent victim to parasitic flies and few specimens can be obtained which are not victims to these unwelcome insects. The figures shown were drawn from specimens obtained in Coimbatore during December and the type larva has been sent to the Society's collections.

COIMBATORE. F. C. FRASER, I.M.S.,
January 6, 1934. *Lt.-Col.*

EXPLANATION OF FIGURES.

a. Side view of larva of *Stauropus dentilinea* Hamp. (The Lobster Moth) in defensive or resting attitude.
b. The same larva moving actively.
c. Terminal somites viewed from above.
d. Anal proleg greatly magnified.
e. First and second legs. (The third pair are rather shorter than the second.)

XX.—THE FLEE-BEETLE *HALTICA CYANEA* WEBER FEEDING ON THE LEAVES OF THE WATER-CHESTNUT (*TRAPA BISPINOSA* ROXB.).

While botanising near Panvel on the 25th February this year I noticed large numbers of the Chrysomelid beetle *Haltica cyanea* feeding on the leaves of the Water-chestnut (*Trapa bispinosa*). The

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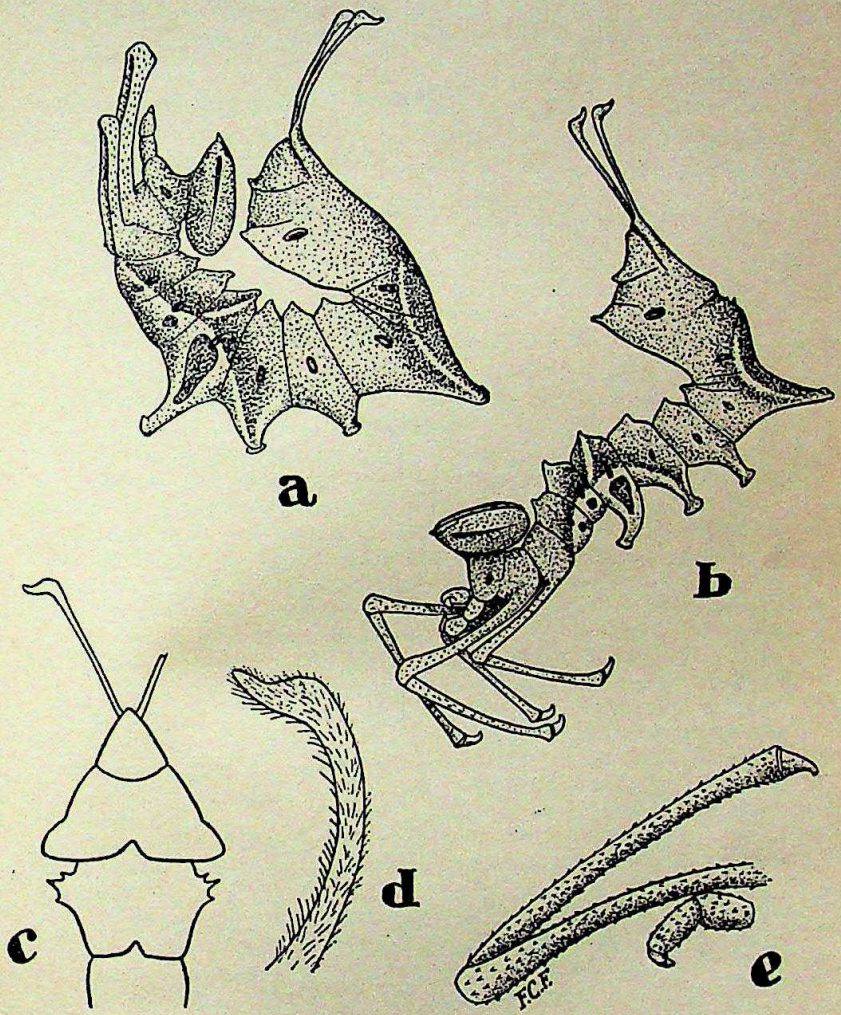

Larva of *Stauropus dentilinea*, Hmps.
(For explanation of figures see end of note.)

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beetles completely destroyed the floating leaves, particularly of the plants nearest the shore of the tank.

Maxwell-Lefroy (*Indian Insect Life*, p. 361) states that the larvae of this species feed on the common weed *Ammania rotundifolia* which comes up abundantly after the rains. This observation I am able to confirm but add that the adult is a common beetle met on most *Ammanias*, even the strong smelling *A. baccifera*, L.

Bombay Natural History Society,
Bombay. C. McCANN,
February 27, 1934. *Asst. Curator.*

XXI.—OUTBREAK OF MILLIPEDES AT JALGAON.

Millipedes are known to be vegetable feeders and are always found in fields and gardens especially in wet places among plants and in decaying vegetable matter. Until the year 1932 at least in this part of India they were never reported to have done any damage to cultivated crops. In July of that year at Jalgaon Farm, East Khandesh, the young seedlings of *jowar*, *tur* and ground-nut were destroyed by these millepedes all of a sudden appearing in enormous numbers. The damage was considerable, so much so, that the jowar crop had to be resown. In the year 1933 exactly in the month of July on the same Farm the appearance of these millipedes was noticed, but the damage was not much in the *jowar* crop. The reason was that there was a break in the rains for about a fortnight and three repeated interculturings, which were necessary to enable the crop to hold out without rains, checked them, whereas last year the conditions were different on account of the wet season. However, in the Cotton Breeder's area the outbreak was very serious. The Cotton Breeder reported that the damage done to cotton plants in the pedigree culture (where every plant had its value) would have been enormous were it not for the severe campaign that was set up against these creatures. The enormity of the numbers can be judged from the fact that no less than two millions of these animals could be hand picked and destroyed from an area of two acres only within the course of four days. The amount of money spent for the collection was about 50 rupees besides the use of a tin of Kerosine oil for destroying them. These millipedes have been identified by Professor Silvestri of Portici, Italy, as a species of *Spirostreptus* allied to sp. *modestus*.

College of Agriculture, V. G. DESHPANDE,
Poona. M.A.G., Ph.D
January 29, 1934.

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XXII.—TERMITE COLLECTING IN SOUTH INDIA FOR FOOD.

It will be interesting to learn that 'white ants' have got an edible value. The queen ants were formerly used for medical purposes but now people use them both medically as well as for food. In Madura, Nagercoil and other places people make big collections of these insects during the rainy months when 'swarming' takes place.

There are two popular methods by which these termites are captured. In some places during the swarming season men dig moderately large pits by the side of the termite nests and fill them with water. Near these pits lighted torches are fixed. The insects attracted by the light crowd over the pits and eventually fall into them. The fallen insects are soon caught and filled in empty bags. This is the light mechanism.

In Madura the method is quite different. In these parts children seem to take more interest in termite collection than men. During rainy months they search for the termite holes and finding one, they blow hardly into it making a shrill sound. The winged termites disturbed by the sound, swarm out and in their attempt to fly they are easily captured in cloth-nets.

The wings and the legs of the termites so collected are removed and the rest roasted with a small quantity of salt and pepper added to it. The roasted white ants are widely used as a delicious article of food. In Nagercoil and such localities it is a common sight to see poor men and women sitting by the road-side and selling these roasted insects as they sell roasted ground-nuts or beans.

GOVERNMENT MUSEUM,

MADRAS. T. V. SUBRAHMANIAM, B.A.

January 28, 1934.

[We recall here a note on Red Ants as food (A. M. Long, vol. xiii, p. 356). The Murries of Bastar, the southernmost Native State in the Central Provinces use red ants as a regular article of food. Whole nests of these insects are taken, torn apart and shaken into a cloth. The occupants mature and immature are beaten into a pulpy mass with a stone and then parcelled into small packets for sale. You may eat the bolus raw after seasoning it with salt, turmeric and chillies or you may cook it with rice flour, chillies etc. into a thick paste. Regular consumption is said to give great power of resistance against fatigue and the sun's heat. The jungle people of Canara have the same liking for red ants as food and deal with them in much the same way as the Murries do. (Aitken, vol. iv, p. 153.) The squashed insect gives

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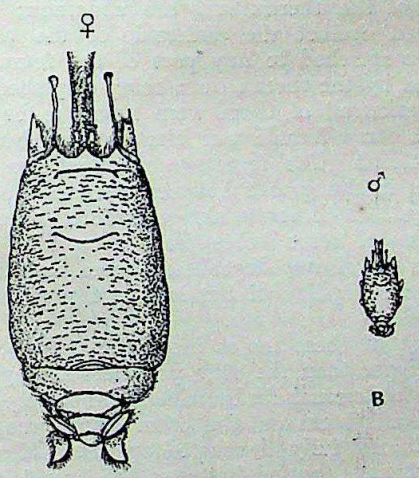
out an acrid smell and when many are being pounded up the 'fumes' which arise make the eyes smart. Aitken suggests that the sensation produced when eating them 'must be like a torch light procession going down the throat'. Apart from food value it is good to know that the acrid aroma of pulverised red ant is a substitute for *smelling salts*.' Tamil coolies in Ceylon use it (A. L. Butler, vol. x, p. 330). The modus operandi is to go to a teeming nest in a bush, seize it with both hands and rub ants and nest together violently between the palms, then take a few good penetrating sniffs of the ammonia-like fumes which arise from the crushed and bruised insects. This, we are told, will instantly relieve a severe cold in the head. The termites which form the subject of the above note are no connections of ants. As a family they are considered relatives of the Cockroaches. Cockroaches as an article of food also provide a long and interesting subject. Space does not permit us to discuss it here.—EDS.].

XXIII.—A NOTE ON THE MALES OF *EMERITA* (*HIPPA*) *ASIATICA*.

No reference to the males of this species occurs in the works of any of the Carcinologists[1] who have dealt with it. The only explanation is that they either failed to notice it, or, which is more probable, their great disparity in size would have caused them to be mistaken for young ones.



A. Female of *Emerita* (*Hippa*) *asiatica*. B. Male.

The carapace of the adult females varies from 22 to 30 mm. in length with an average of 25 mm., while the largest male I have been able to secure at this place has a carapace length of only

[1] Milne Edwards, 1837; Heller, 1868; Miers, 1879; Henderson, 1893; Nobili, 1903.

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7.5 mm. The corresponding lengths for the two American species *E. emerita* and *E. analoga* are respectively 20 to 22 mm. (female), 14 mm. (male) and 22.4 mm. (female), 12 to 14 mm. (male). It is thus seen that though the adult females of the Asiatic species are decidedly larger than their American confreres, the males are only about half of those of the latter. There is, however, no positive evidence to show that they do not grow beyond this size; but the failure to secure larger ones, though collections were continued for more than two months amounting to a couple of hundred specimens, seems to show that such is the case.

A very interesting point about their habits that has been observed seems worth mentioning here. In the months of March and April the narrow zone of the low water mark was teeming with the young ones of this animal, so that one can collect several by simply scooping up a handful of sand. A collection made at this time shows a good number of males, which can be easily recognised by the presence of the genital papillae on the coxopodites of the last pair of thoracic legs. They varied from 4 to 6 mm. in the length of their carapace. No attempt was made to collect them in the next two months. In July, however, they had grown considerably and all of the large ones were females. This inexplicable absence of large sized males led to a more careful search and it was then discovered that adult females which had recently moulted and were therefore softbodied had each two or three, and sometimes more, young individuals on the ventral side between the posterior part of the thorax and the abdomen; the latter being normally pressed against the underside of the thorax. They do not seem to be attached to any part of the female; but are probably prevented by the thorax from being displaced.

On examination all of them were found to be males. In one or two cases a stray female was also noticed, but that seems to be only exceptional. The females carrying them had a mass of spermatophores in the groove between the sixth and seventh pair of thoracic legs. In *Emerita* also therefore, as in several other crabs, the union of sexes takes place soon after moulting. The spermatophores are simply deposited on the ventral surface of the female, the coxal papillae of the last legs probably aiding in the process.

The smallest of these males measured only 3.5 mm., that is only slightly bigger than the first post larval stage and possessed vestiges of the abdominal limbs which completely disappear later. The reproductive system on the other hand was well developed and often contained fully developed sperms. Most of the males secured from females varied between 3·5 and 6 mm. in length, larger ones being only found very rarely in association. In some of these specimens a part of the long string of spermatophores was actually seen protruding through the genital opening. There is therefore no doubt that these are fully mature individuals.

Though the habits of the two American species have been studied by several authors, nothing so far as I am aware, has been recorded about such an early association of sexes as obtains in the case of the present form.

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The very early development and maturation of the sexual organs in young ones which have probably undergone only a single moult after the first post larval stage (as indicated by the size) is also a very interesting phenomenon in the Decapoda. It appears that sex differentiation takes place at a very early stage in the life of this form and the males, whenever possible, come into association with the females soon after leaving their free swimming existence.

In a few instances one or two of the smallest individuals were in the process of ecdysis which might indicate that in their case at any rate the association is not quite temporary.

In the allied form *Albunea*, one species of which, *A. symnista*, exists side by side with *Emerita* at Madras, adult males attain to about two-third of the size of females and are easily got at certain times of the year. It would seem therefore that the case of the latter is an instance of premature sexual maturity. Secondary sexual characters like greater size, differently shaped chelipeds, narrow abdomens and so on are frequent in male Decapods. Dimorphism of males, the two forms in some cases being 'alternating breeding and non-breeding phases in the life-history of the same individual' has also been noticed among some Crayfishes and crabs belonging to the subtribe *Oxyrhyncha*. But instances parallel to that of *Emerita* do not seem to be of common occurrence. The fate of these males, after the transference of the reproductive elements should therfore be of great interest and it is hoped that a systematic search to be made hereafter would yield definite information bearing on it.

MADRAS. M. KRISHNA MENON, M.A.

XXIV.—OCCURRENCE OF *ISOËTES COROMANDELINA* L. IN THE BOMBAY PRESIDENCY.

In vol. xxxv, p. 471, I recorded the occurrence of a species of Isoëtes in the Presidency. I submitted the material for examination and report to Dr. H. Reimers of the Botanischen Garten und Botanischen Museum, Dahlem (Berlin). He writes: "There is only one species in East India, namely *Isoëtes coromandelina* L. Your plant is a large form of this species and agrees very well with *I. brachyglossa* Braun described in 1862 from the Nilgiris (Wight No. 309) but now considered as a mere form of *I. coromandelina*. The species is also represented in our herbarium from Madras and Terampur[1] (near Calcutta ?). In N. E. Pferffer's monograph of the Isoëtaceae (Annals of the Missouri Bot. Garden, vol. ix, 1922) the following species are recorded from 'Peninsula India Wight Crypt. No. 4; 'Peninsula India' leg. Royle; Madras leg. Fyson 1913; Madras, near Seven Pagodas leg. Kashyan 1922.

[1] This is obviously a mistake for 'Serampur' which is near Calcutta.

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The type specimens of *I. coromandelina* were collected by König in the 'Coromandel'. The species was described by Linné fil. in 1781 (Suppl. Plantarum, p. 447). We have in Berlin specimens probably from the type collection in the Willdenow Herbarium.

Now I give a short description of the species.

Corm 3-lobed (in other species 2-lobed); leaves 16-20 cm. long, with very wide membraneous wings at base, extending above the sporangium level; stomata numerous in upper region, lacking in basal portion of leaves; peripheral strands 'sklerenchym-strang' present, 4 very strongly developed with several weaker accessory; ligule conspicuous, *very wide and short*, often appearing truncate in older leaves but pointed in young leaves (after Braun *I. coromandelina* has a pointed ligule, *I. brachyglossa* a truncate one); sporangium large 12 × 9 mm.; velum none; megaspores white when dry, grey when moist, 480-540 μ in diameter, *marked with numerous large tubercles*, closely arranged and occasionally extended into very short rounded ridges; microspores red-brown or paler, 26-33 μ smooth."

My thanks are due to Dr. Reimers for the trouble he has taken over my material.

Bombay Natural History Society,
Bombay.
January 7, 1934.

C. McCANN,
F.L.S.,
Asst. Curator.

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PROCEEDINGS OF THE ANNUAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY.

The Annual General Meeting of the Society was held at the Prince of Wales' Museum on Monday the 19th March, 1934, at 6 p.m. Sir Reginald Spence was in the Chair.

AGENDA.

1. Reading of the Annual Report of the Committee.
2. Presentation of the Balance Sheet and Statement of Accounts for the past year.

WILD ANIMALS OF THE INDIAN EMPIRE AND THE PROBLEM OF THEIR PRESERVATION.

The Plates for this serial were not received in time for publication. Part III which deals with the Carnivora will appear in the next issue of the Journal.

BOMBAY NATURAL HISTORY SOCIETY.

OFFICE BEARERS—1934.

Patrons.—His Excellency The Viceroy of India; H. R. H. The Prince of Wales, K.G.

Vice-Patrons.—H. H. The Maharao of Kutch, G.C.S.I., G.C.I.E.; H. H. The Maharaja of Jodhpur, K.C.S.I., K.C.V.O.; H. H. The Maharaja of Rewa, K.C.S.I.; H. H. The Maharaja of Bhavnagar; H. H. The Maharaja of Travancore; Mr. F. V. Evans, Liverpool; Sir David Ezra, KT., F.Z.S., Calcutta; Mr. A. S. Vernay, New York and London.

President.—H. E. The Right Hon'ble Lord Brabourne, G.C.I.E., M.C.

Vice-Presidents.—H. H. The Maharao of Kutch, G.C.S.I., G.C.I.E.; Rev. E. Blatter, S.J., PH.D., F.L.S.; The Hon'ble Mr. R. D. Bell, C.S.I., C.I.E., I.C.S.

Executive Committee.—Right Revd. R. D. Acland, Bishop of Bombay, Mr. Farrokh E. Bharucha, Rev. Fr. J. F. Caius, S.J., Mr. C. B. B. Clee, I.C.S., Mr. Alwyn Ezra, F.R.G.S., F.Z.S., Mr. J. B. Greaves, M.L.C., Prof. V. N. Hate, B.SC., Mr. J. G. Ridland, Lt.-Col. S. S. Sokhey, I.M.S., Mr. A. Forrington (*Honorary Treasurer*), Mr. P. M. D. Sanderson, F.Z.S. (*Honorary Secretary*), Mr. H. M. McGusty, Bombay.

Advisory Committee.—Dr. C. F. C. Beeson, D.SC., M.A., I.F.S., Dehra Dun. Mr. T. R. Bell, C.I.E., I.F.S. (Retd.), Karwar. Lt.-Col. R. W. Burton, I.A. (Retd.), Coonoor. Mr. C. H. Donald, F.Z.S., Dharmsala. Lt.-Col. F. C. Fraser, I.M.S., Coimbatore. Dr. F. H. Gravely, D.SC., Madras. Mr. S. F. Hopwood, I.F.S., Rangoon. Mr. C. M. Inglis, M.B.O.U., F.Z.S., Darjeeling. Mr. R. C.

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AGENDA.

1. Reading of the Annual Report of the Committee.
2. Presentation of the Balance Sheet and Statement of Accounts for the past year.
3. Election of the Committee.
4. Such other business as may be properly brought before the meeting.

Mr. P. M. D. Sanderson announced the election of 61 members. These included the Governors of the Central Provinces and of the United Provinces. His Excellency the Governor of Bombay Lord Brabourne has honoured the Society in becoming its President.

In presenting the Report for the year 1933, Mr. Sanderson said that there were 3 important events during the year: one was the completion of the thirty-sixth volume of the *Journal;* the second the Fiftieth Anniversary of the founding of the Society; and the third the decision of the Trustees of the Prince of Wales' Museum to build an extension to the existing building to which the Natural History Section would be transferred and in which it would have the much needed additional space.

Mr. Sanderson then reviewed the main contribution to the *Journal,* to the various activities of the Society during the year as embodied in the Report which is printed in this number.

Mr. A. Forrington, Honorary Treasurer presented the balance sheet and statement of accounts for the year 1933 which were duly adopted. The Balance Sheet and Statement of Accounts are issued with the Report.

The following gentlemen were elected to serve on the Society's Executive and Advisory Committees during the year 1934:—

BOMBAY NATURAL HISTORY SOCIETY.

Office Bearers—1934.

Patrons.—His Excellency The Viceroy of India; H. R. H. The Prince of Wales, K.G.

Vice-Patrons.—H. H. The Maharao of Kutch, G.C.S.I., G.C.I.E.; H. H. The Maharaja of Jodhpur, K.C.S.I., K.C.V.O.; H. H. The Maharaja of Rewa, K.C.S.I.; H. H. The Maharaja of Bhavnagar; H. H. The Maharaja of Travancore; Mr. F. V. Evans, Liverpool; Sir David Ezra, Kt., F.Z.S., Calcutta; Mr. A. S. Vernay, New York and London.

President.—H. E. The Right Hon'ble Lord Brabourne, G.C.I.E., M.C.

Vice-Presidents.—H. H. The Maharao of Kutch, G.C.S.I., G.C.I.E.; Rev. E. Blatter, S.J., Ph.D., F.L.S.; The Hon'ble Mr. R. D. Bell, C.S.I., C.I.E., I.C.S.

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Advisory Committee.—Dr. C. F. C. Beeson, D.Sc., M.A., I.F.S., Dehra Dun. Mr. T. R. Bell, C.I.E., I.F.S. (Retd.), Karwar. Lt.-Col. R. W. Burton, I.A. (Retd.), Coonoor. Mr. C. H. Donald, F.Z.S., Dharmsala. Lt.-Col. F. C. Fraser, I.M.S., Coimbatore. Dr. F. H. Gravely, D.Sc., Madras. Mr. S. F. Hopwood, I.F.S., Rangoon. Mr. C. M. Inglis, M.B.O.U., F.Z.S., Darjeeling. Mr. R. C.

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Morris, F.R.G.S., F.Z.S., Coimbatore. Major E. G. Phythian-Adams, F.Z.S., I.A. (Retd.), Nilgiris. Dr. Baini Prashad, D.Sc., Calcutta. Mr. H. C. Smith, I.F.S., Burma. Lt.-Col. C. H. Stockley, O.B.E., D.S.O., M.C., Meerut. Mr. J. H. Williams, Coimbatore.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY. FOR THE YEAR ENDING 31st DECEMBER 1933.

ADMINISTRATION.

President.—H. E. the Right Hon'ble Major-General Sir Frederik Sykes, P.C., G.C.I.E., G.B.E., K.C.B., C.M.G.

Vice-Presidents.—H. H. The Maharao of Kutch, G.C.S.I., G.C.I.E.; Rev. E. Blatter, S.J.; The Hon'ble Mr. R. D. Bell, C.S.I., C.I.E., I.C.S.

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Staff.—S. H. Prater, M.L.C., J.P., C.M.Z.S. (*Curator*). C. McCann, F.L.S. and V. S. La Personne (*Assistant Curators*).

THE HONORARY SECRETARY'S REPORT FOR THE YEAR 1933.

The Society's Journal.

The Thirty-sixth Volume of the *Journal* was completed during the year under review.

Scientific Papers.—Mammals.—Mr. R. I. Pocock continued his important papers on Indian Mammals. His papers constitute a revision of the various genera and species based on all records and data available. During the period under review he published a revision of the 'Civet-Cats of Asia' and in Part IV appeared the first part of his paper dealing with 'The Palm Civets or "Toddy-Cats" of the Genera *Paradoxurus* and *Paguma* inhabiting British India.'

In dealing with the Civet-Cats of Asia, Mr. Pocock revised the group *Viverrinae*, which includes the large and small Civets (*Viverra* and *Viverricula* of older authors). His diagnosis is based mainly on the structure of the feet and the cranial characters. In his opinion the genus *Viverra*, as previously understood, embraced animals whose characters are worthy of distinctive generic rank. He accordingly split up the genus into two, retaining the genus *Viverra* to contain the Large Indian Civet (*V. zibetha*) and the Malay Civet (*V. tangalunga*) and placed the Burmese Civet (*V. megaspila*) and the Malabar Civet (*V. civettina*) in a separate genus:—*Moschothera*, created by him. This arrangement is based on the presence or absence of skin-lobes forming claw sheaths on the 3rd and 4th digits. In the genus *Viverra* these particular claw sheaths are present whereas they are absent in the genus *Moschothera*. The author describes five races of *V. zibetha*, four of which occur within Indian limits.

In the second part of this paper the author deals with the Small Indian Civets of the genus *Viverricula*. Mr. Pocock has shown that the old name, *V. malaccensis* of Gmelin, is inadmissible on the ground that the name was misapplied to this species and must therefore give place to the name *indica* of Geoffroy. The author has divided the single species up into 11 geographical races.

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Mr. Pocock in a second paper, on the Palm Civets, the first part of which appeared in Part IV of the *Journal*, revises the two genera *Paradoxurus* and *Paguma*. This paper is based mainly on the fine material obtained by the collectors of the Society's Mammal Survey. The author admits only three species as representatives of the genus *Paradoxurus*:—namely the Ceylon Palm Civet, *P. zeylonensis*, the South Indian Palm Civet, *P. jerdoni*, and the Indian Palm Civet, *P. hermaphroditus*. The first named is without any subspecies, the second has been split up into two races, and the last into several races. The paper is in the course of publication.

Mr. C. McCann, the Assistant Curator of the Society, published a paper on the colouration and habits of the White-browed Gibbon or Hoolock. In this paper, the author indicates that there is a complete change of colour in this gibbon from birth to maturity and that this is more evident in the case of the females. Till recently, it was generally accepted that the black and fawn colour was assumed by both sexes, but the author has been able to show that only the females become fawn when they reach maturity and that the males remain black throughout life, after passing through the creamy juvenile phase. The misconceptions which have arisen regarding the colouration of the gibbon are attributed to incorrect sexing of the animals. The length of the peniform clitoris, when superficially examined, has led to the confusing of females with males.

In Part III Mr. McCann published an account of some of the Indian Langurs. The paper is based on material collected by himself and numerous notes made in the field over a period of a number of years. The author is of opinion that there is much variation in the colour in the coat from birth to maturity and that the colouration probably varies also with season and environment. The author also deals with some of the much debated popular beliefs relative to the social life of Langurs and indicates the reasons for some of the errors that have been made.

In Part IV of the volume of the *Journal* under review Mr. McCann contributed a paper on Indian Macaques. He described in detail the little known species *Macaca speciosa*, the Stump-tailed Macaque, from material obtained by him in the Naga Hills, Assam. The paper deals with the colour phases and anatomical changes passed through by these animals from birth to maturity. Mr. McCann is of the opinion that the annulation of the fur may possibly be correlated with the development of the teeth and thereby provide an index of maturity. Along with the article the author has published some good photographs of the adults of this species in the flesh.

Birds.—Three further reports (IV-VI) dealing with the collections obtained by the Vernay Survey of the Eastern Ghats, were published by Mr. H. Whistler and Mr. N. B. Kinnear during the period under review. This brings the Survey material now dealt with as far as the Wagtails (*Dendronanthus*).

Three parts dealing with the Hyderabad State Ornithological Survey were published during the year by Mr. S. A. Ali, who is being assisted by Mr. H. Whistler. We published an introductory account of the origin of the Survey in Part II of the *Journal* under review. The Nizam's Dominions, except perhaps for a few stray records, were a closed book to the ornithological world. The report deals not only with the birds met with by the Survey, but also with all known records thus making the results as complete as possible. A study of the published records and the collection made available by the Survey necessitated a revision of some of the hitherto known geographical races.

Mr. Ali who undertook the Survey himself has added much valuable data by way of carefully recorded field notes which have added greatly to the value of the report.

The thanks of the Society are due to Mr. Ali for the painstaking thoroughness with which he conducted the Survey and the careful way he has prepared the report and to the Nizam's Government for their generous assistance.

In Part IV, Dr. Ticehurst contributed a paper on 'Some Birds from Southern Arakan'. This paper is based on a collection made by Mr. Villar while on tour through the Arakan Yomas. The services of the Society's collector, Mr. Henricks was loaned to Mr. Villar. The collection comprised 357

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specimens of birds. Dr. Ticehurst is of the opinion that extensive collecting is necessary in Arakan before it can be ascertained what forms occur and any definite conclusion arrived at.

Fishes.—In Part III Dr. S. L. Hora published a report on the Fishes of Afghanistan. This report was based on specimens collected by the Military Attache, British Legation, Kabul. The specimens were secured in the Paghman River. With the aid of this collection Dr. Hora was able to amplify some of McClelland's original descriptions. The author considers that Afghanistan is an important area from a zoo-geographical point of view. It forms the boundary line between the Indian element and that of Turkestan. The affinities of the Afghan fish fauna have to be sought further to the north-east. According to the author the Indian element in the fauna does not extend beyond Jalalabad.

In Part IV Mr. Mukerji commenced his report on Burmese Fishes. This report is based on a collection of fish made by Lt-Col. R. W. Burton from the tributary streams of the Mali Hka River in the Myitkyina District. The collection contained 78 specimens comprising 32 species. The author considers that the fish fauna of Burma, beside including endemic species, includes forms which are identical with or related to Indian fishes, particularly those found in the adjacent provinces of Bengal and Assam. There are also to be found forms essentially Chinese or with Indo Australian affinities. The paper is still in the course of publication.

Insects.—In Part II Mr. J. A. Yates published a paper on the butterflies of Bangalore and the neighbourhood. His paper is based on a collection made by himself and on the collection and notes of Col. H. C. Winchworth who did much collecting in the area.

In Part III Mr. M. E. Mosley commenced a series on the Caddis Flies, but owing to the late arrival of the MS. the continuity of the series had to be broken. In this paper the author attempts to popularise and encourage the study and collecting of Caddis Flies, by giving a detailed account of their life history and habits. The paper is still in the course of publication.

In Part IV Lt.-Col. F. B. Scott published a paper on the foodplants of Indian Hawkmoths. The author in his paper shows the interrelation that exists between the distribution of hawkmoths and their food plants. The distribution of Hawkmoths and the number of individuals in any locality is intimately connected with their choice of food plants and the distribution of these food plants. The extinction of a certain plant in a particular locality will result in the disappearance of the particular species of moth which feeds on it.

In the same Part, Mr. B. Krishnamurti contributed a paper on the biology and morphology of *Epipyrops eurybrachydis*, a species of moth parasitising *Eurybrachys tomentosa*, one of the members of the aphid group.

During the period under review we published a paper by Col. F. C. Fraser in which he makes additions to the Dragonfly fauna and also describes two new species. He also contributed part xli of his series on Indian Dragonflies. Col. Fraser is now engaged writing the volumes on the Dragonfly fauna of India for the Fauna of British India series, the first volume of which appeared during the period under review.

Botany.—During the year we published parts xx, xxi, and xxii of Rev. Father Blatter's Revision of the Flora of the Bombay Presidency. The parts deal with the *Balsaminaceae*, *Rutaceae*, *Asclepiadaceae*, and *Rubiaceae*. The *Asclepiadaceae* and the *Rubiaceae* were written in collaboration with Mr. Mc Cann. They include descriptions of new species and many necessary changes in nomenclature, thereby bringing it up to date in accordance with recent publications.

In Part II of the *Journal* Fr. Blatter published the descriptions of twelve new species of plants from Waziristan. In the subsequent issues Fr. Blatter published the first part of his Flora of Waziristan in collaboration with Mr. J. Fernandez. The material for this flora was collected by the authors when on expedition in the area.

The thanks of the Society are due to Fr. Blatter for his valuable contributions on Indian Botany to the *Journal*. In spite of very indifferent health

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he has carried on his labours without interruption and we hope that he will be spared to continue and to complete his great work.

Popular Papers.—During the year under review we published part xix of vol. v of Mr. Stuart Baker's popular serial on Indian Waders which is now close on completion. We hope that Mr. Stuart Baker will continue to contribute to the Society's *Journal*. He has written for our *Journal* for close on 12 years and has done much to increase its popularity and interest.

Parts xi, xii and xiii, of the serial on Beautiful Indian Trees by Rev. Fr. Blatter and Mr. W. S. Millard were issued during the year. Our thanks are due to the authors for these contributions which add so much to the interest and attraction of the *Journal*.

Mr. W. S. Thom wrote on Some Experiences amongst Elephants and other big game in Burma from 1887-1931. In this interesting article the author narrates his varied experiences and gives sound advice to younger generations of sportsmen.

In the same number (No. 2) Mr. J. C. Higgins commences his article on The Game Birds and Animals of the Manipur State with notes on their number, migration and habits. During the year we published parts 1-3. This paper forms a carefully kept record of all the game shot in Manipur State from 1911-1931.

In Part II of the *Journal*, Mr. S. H. Prater, Curator of the Society, contributed two papers on snakes, one dealing with 'Non-poisonous' Snakes and the other on the Social Life of Snakes. In the first paper the author discusses the use of the term 'non-poisonous' and shows that the majority of snakes are poisonous and equipped with the means of paralysing or killing their prey with their venom. It is not the quality of the poison but the quantity which they inject which controls their power for harming animals which are larger than their accustomed prey. The paper records the investigations carried out by Bertrand, Phisalix and Caius on the toxicity of the venoms of various Silyburine and Colubrine snakes which prove that the venoms which they secrete are sufficiently powerful to kill or paralyse their legitimate prey and that the limited quantity secreted alone prevents them from becoming dangerous to larger animals.

In his second paper Mr. Prater discusses the social life of snakes and the much debated question as to whether a snake traces its mate. He holds that there is much to be said for snakes following on the trail of one another, when driven by sexual impulses. This following is effected by scent. Snakes possess a scent gland near the anus and leave a scent trail behind them wherever they go.

In Part III Dr. Hora published an interesting and valuable paper on the Respiration in Fishes. The article deals with the different means of respiration which have been evolved by fish living under different conditions and assuming different modes of life.

Economics.—During the year Mr. Rai published the second and last part of his Report on the Survey of the Shell Fisheries of the West Coast. The author in this part of his paper deals with the *Crustacea*, the Lobsters, Prawns and Crabs, and the methods employed in catching and preserving them for export. He has shown the necessity of safeguarding the industry and is of the opinion that steps should be taken to improve the industry and prevent the catching of breeding and undersized individuals. He suggests that a closed season should be observed after the necessary investigations have been made regarding the breeding habits and local movements.

In 1933 Mr. Sorley published his Report on the Marine Fishes of the Bombay Presidency. While the Report shows a grasp of the economic, sociological and statistical problems underlying the development of fisheries, its attitude towards Scientific Research is less convincing. While the Report admits the need for research and indicates that the author was greatly handicapped because of the absence of data, it recommends that Government, as such, should have nothing to do with research and relegates the work to private bodies but makes no recommendation as regards the co-ordination of research or the financial assistance to private bodies undertaking it.

Government have appointed a Fisheries Officer, but under the present cir-

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cumstances he cannot possibly have the time to investigate the biological problems which Mr. Sorley in his report admits require immediate investigation. Apart from this, the problems are so vast and cover so many distinct fields of research, that it would require the attention of a number of specialists. Government could make a small beginning by availing themselves of the services of 2 or 3 men who, as a minimum qualification, should have obtained the M.Sc. degree. These men could be paid a small honorarium. They could work under the direction of the Fisheries Officer, who could place practical problems before them for investigation. Hydrographical and Morphological research could be carried out by the teaching staff of the University. The identification of species could be effected through the agency of the Society which is in touch with experts in the Zoological Survey of India and the British Museum.

A study of the habits, food, growth, parasites and enemies of fishes could best be investigated by the establishment of a Marine Aquarium. Every one who has studied the question will agree with Mr. Sorley when he says that a Marine Aquarium if established in Bombay will be self supporting. Complete plans for an Aquarium in Bombay were made by the Society but the scheme is held in abeyance for want of money. If an Aquarium could be built in Bombay no special staff would be required for managing it as this could be done by the officials of the Society. Research work in the aquarium could be effected through the Fisheries Officer and his scientific assistants. Apart from its recreational and educational value the Aquarium would become a factor in the development of local fisheries. Finally Government should establish a Board of Fisheries on which representatives of the Society and other scientific institutions should find a place, together with such other interests as government might like to consult. Among others we would recommend a representative of the Zoological Survey of India and of the Madras Fisheries department. There is need for co-operation between Fishery experts of various provinces.

Preservation of the Fauna.—During the period under review the first part of the series dealing with the Preservation of the Fauna of this country appeared in Part IV of the *Journal*, as a separate supplement. A foreword to the series was written by H. E. the Viceroy. The Introduction gives a broad outline of the various problems underlying the question of wild life protection in this country and indicates the need for a concerted policy and concerted action on the part of the State. It is followed by a short sketch of the geographical features of the country and the animal life inhabiting it. It stresses the necessity for giving the matter sufficient publicity and awakening the interest of the public. This is followed by descriptions of the animals together with coloured and black and white illustrations. The thanks of the Society are due to Mr. F. V. Evans of Liverpool who has very generously paid for the illustrations and to Their Highnesses the Maharaja of Chamba State, Jodhpur, Travancore, Bhavnagar, Rajgarh and Junagadh who have generously contributed to the cost of printing these articles. Various authors have contributed their views to the present position of game in their particular districts and suggested measures that should be adopted for the protection of the fauna in their localities. Mr. Dunbar Brander deals with the Central Provinces and Mr. G. Monteath with the Bombay Presidency.

Miscellaneous Notes.—The Miscellaneous Notes which comprise the observations of numerous individuals add greatly to the interest of the *Journal*. Our thanks are due to all the authors of the various papers who have contributed so much to make the *Journal* a success.

Expeditions and Explorations.—The Society was able during the year to undertake an Ornithological Survey of the Jodhpur State. Mr. V. S. La Personne conducted the Survey. Our grateful thanks are due to His Highness the Maharaja of Jodhpur for a grant of Rs. 3,500 made by him towards the cost of the expedition and to his officers for the assistance they gave to the expedition.

Expenditure and Receipts.—The total anticipated income of the Society for the year 1933 was Rs. 38,024-15-9. Actual receipts amounted to Rs. 39,948-9-4

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as compared with Rs. 36,399-8-5 during 1932, shewing an increase of Rs. 3,549-0-11.

The increase in revenue is mainly due to receipts under the following heads:—

	1932	1933
	Rs.	Rs.
Life Membership	700	1,950
Entrance Fees	678	1,070
Savings in Jodhpur Survey ...	...	600

All other receipts are within estimated income.

The following figures show comparatively the number of members on the roll of the Society (excluding Life Members) on the 1st of January 1933 and 1934 and the number who paid their subscription during the year:—

	No. of Members on Roll	No. of Members who paid subscription
1933, 1st. January	963	893
1934, 1st. January	979	888

During the year 1933 the Society has lost 91 members from resignations, while new members for this period amount to 107.

1933 was the Jubilee year of the Society in which it completed 50 years of continuous progress. To enable it to continue its work the Society requires the generous support of its members. This help they can give most effectively by continuing their membership and inducing their friends to join. We would greatly appreciate the active co-operation of members at the present time.

A Special Meeting to commemorate the Fiftieth Anniversay of the Society was held at the Cowasjee Jehangir Hall on the 10th August 1933 at 9-45 p.m. Sir Hugh Cocke, the Sheriff of Bombay, was in the chair. His Excellency the Viceroy was unfortunately unable to be present, but a special message was received from His Excellency the Governor of Bombay, the President of the Society, congratulating the Society on the great work it had accomplished during the 50 years of its existence and wishing it all success in the future.

Mr. P. M. D. Sanderson, Honorary Secretary, gave a brief History of the Progress and Development of the Society. He was followed by Mr. S. H. Prater, the Society's Curator, the subject of whose address was the 'Problem of Wild Life Protection in India'. The text of Mr. Prater's address on Wild Life Protection appeared in the Supplement to volume xxxvi, No. 4.

The text of Mr. Sanderson's speech is not published as it is proposed to issue shortly a special Jubilee Number of the *Journal* which will give an account of the origin and growth of the Society and provide a record of its various activities during the last 50 years of its existence.

The thanks of the Committee and Members of the Society are due to Mr. A. S. Vernay who has given the Society a special donation to meet the cost of printing this Special Number.

Sir Reginald Spence.—The Committee wished to place on record their thanks and appreciation of Sir Reginald Spence's services to the Society as Honorary Secretary and Editor of its *Journal*. The progress the Society has made during the past 10 years was largely due to his able management of its affairs. His departure from India is a great loss and it is hoped that he will continue his interest in the Society and that we shall continue to receive the benefit of his help, and encouragement.

Staff.—The Committee take this opportunity of placing on record their appreciation of the services of the Curator and his staff whose labours have enabled it to continue and maintain the standard of its work under the difficult conditions which prevail at present.

P. M. D. SANDERSON,
Honorary Secretary.

12th March, 1934.

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BOMBAY NATURAL HISTORY SOCIETY.

BALANCE SHEET AS AT 31st DECEMBER 1933.

LIABILITIES	Rs A P	Rs A P	ASSETS	Rs A P	Rs A P
Life Membership Fees as per last Balance Sheet.	.....	47,150 0 0	*Investments as per last Balance Sheet or market value on 31st December 1933, whichever is lower :*		
Donations for specific objects unexpended :			Rs. 28,000 Govt. 3½% Pro. Notes at Rs. 74-9/16%...	20,877 8 0	
Show Cases, etc. in existing building ...	2,133 11 4		,, 10,000 ,, do do. 82-11/16%.	8,268 12 0	
Show Cases in new building	17,147 2 4		,, 15,000 ,, 5% 1945-55 To an at par.	15,000 0 0	
Jubilee Number Fund	1,500 0 0		,, 8,000 ,, 6½% Dev. Loan ...	8,000 0 0	
Journal Fund	7,533 7 0		,, 14,000 Port Trust 4% Bonds at 77% ...	10,780 0 0	
Jodhpur Survey	616 7 3		,, 15,000 Imp. ,, 4% ,, at 76% ...	11,400 0 0	74,326 4 0
		28,930 11 11			
Sundry Creditors :			*Investments on account of Building Fund :*		
Printers of Journals	3,584 6 9		Rs. 10,300 Govt. 4% Last 1934-37 at par. ...	10,300 0 0	
,, ,, Game Books, Vol. III ...	889 7 1		,, 5,700 ,, 5½% ,, 1938-40 ,, ...	5,700 0 0	
For Expenses	250 0 0		,, 500 ,, 5 % ,, 1945-55 ,, ...	500 0 0	
		4,723 13 10			16,500 0 0
Surplus Assets—			*Cash—*		
Balance as per last Balance Sheet ...	37,522 15 2		With National Bank of India Ltd., Bombay	11,466 14 3	
Less—Loss on Revenue Account Rs. A. P. 2,452 8 9			With National Bank of India Ltd., London	257 3 7	
Fluctuation in the value of 3½% G. P. Notes of Rs. 10,000 purchasd in 1933 ... 318 12 0			On hand	150 0 0	11,874 1 10
			Sundry Debtors	...	714 13 0
Add : Surplus on Publication Account ...	2,771 4 9		*Furniture*	1,727 0 0	
	34,751 10 5		*Less* Depreciation	50 0 0	1,677 0 0
	104 11 6		*Publications, excluding Journals :*		
		34,856 5 11	As certified by the Secretary	...	300 0 0
			Game Books, Vol. III : Stock on hand as certified by the Secretary	...	1,098 3 8
			Bird Charts, Stock on hand as certified by the Secretary	...	5,962 9 7
			Bates' Bird Life : Stock on hand as certified by the Secretary	...	1,197 6 6
			Butterfly Books : Stock on hand as certified by the Secretary	...	496 2 10
			Beautiful Indian Trees : Stock on hand as certified by the Secretary	...	1,514 6 3
Total ...		1,15,660 15 8	Total ...		1,15,660 15 8

Note.—A stock of 21,535 old Journals and the Valuable Research Collection and Library of 2,550 volumes have not been taken into account on the Asset side of the Balance Sheet.

We have prepared the above Balance Sheet from the cash book and from information given to us, and have verified the investments.

In our opinion, such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of our information and explanations given to us.

BOMBAY, *17th February, 1933.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants, Auditors.

(Sd.) A. FORRINGTON,
Honorary Treasurer.

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BOMBAY NATURAL HISTORY SOCIETY.

REVENUE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER 1933.

	Rs A P	Rs A P		Rs A P	Rs A P
To Salaries	19,060 9 0		By Life Membership Fees	1,950 0 0	
,, Society's Contribution to Provident Fund	1,539 3 0		,, Subscriptions	23,467 0 6	
,, General charges	568 2 7		,, Entrance Fees	1,070 0 0	
,, Rent	2,435 0 0		,, Sales of Journals	2,093 14 7	
,, Stationery and Printing	355 5 0		,, Interest on Investments	3,507 13 11	
,, Postage	1,110 10 0		,, Taxidermy Department	473 2 9	
,, Library	411 5 4		,, Profit on Sale of Investments	150 0 0	
,, Audit Fee	250 0 0		,, Bird Mounting	500 0 0	
,, Insurance	100 0 0		,, Sales of Games Book, Vols. I & II ...	822 5 4	
,, Furniture Depreciation	50 0 0				34,034 5 1
,, Cost of Printing Journals	10,595 10 11		,, Loss	2,452 8 9	
		36,486 13 10			
Total ...		36,486 13 10	Total ...		36,486 13 10

PUBLICATION ACCOUNT FOR THE YEAR ENDED 31st DECEMBER 1933

	Rs A P	Rs A P		Rs A P	Ks A P
To Cost of Printing Fish Pamphlets ...	64 0 0		By Snake Charts	85 0 0	
			Society's Publications	57 3 6	
,, Balance carried to Surplus Assets ...	104 11 6		,, Fish Pamphlets	26 8 0	
		168 11 6			168 11 6
			,, Sales of Bird Charts and Album ...	1,857 5 1	
,, Stock of Bird Charts and Albums ...	.....	7,819 14 8	,, Stock on hand	5,962 9 7	
					7,819 14 8
,, Stock of Game Book, Vol. III	1,466 0 8	1,466 0 8	,, Sales of Game Books, Vol. III	367 13 0	
			,, Stock on hand	1,098 3 8	
					1,466 0 8
,, Stock of Bates' Bird Life	.....	1,295 0 6	,, Sales of Bates' Bird Life	97 10 0	
			,, Stock on hand	197 6 6	
					1,295 0 6
,, Stock of Butterfly Books...	.....	781 2 10	,, Sales of Butterfly Book	285 0 0	
			,, Stock on hand	496 2 10	
					781 2 10

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BOMBAY NATURAL HISTORY SOCIETY.

INCOME AND EXPENDITURE ACCOUNT OF DONATIONS FOR SPECIFIC PURPOSES FOR THE YEAR ENDED 31st DECEMBER, 1933.

	Rs a p	Rs a p		Rs a p	Rs a p
To Expenditure on Show Cases, etc. ...		4,144 7 6	By Unexpended Balance for Show Cases, as per last Balance Sheet	2,253 2 10	
,, Balance carried to Balance Sheet ...		2,133 11 4	,, Donations for Modeller's Salary etc. ...	4,025 0 0	6,278 2 10
		6,278 2 10			6,278 2 10
,, Premium paid on purchase of 4% 1934-37 Loan	152 4 0		,, Unexpended balance for Show Cases in New Building as per last Balance Sheet	16,313 11 3	
,, Balance carried to Balance Sheet ...	17,147 2 4	17,299 6 4	,, Profit on Sale Proceeds of the Terminal Loan	292 12 0	
			,, Interest on Investments	692 15 1	17,299 6 4
,, Carried to Balance Sheet		1,500 0 0	,, Jubilee Fund		1,500 0 0
,, Expenses in Printing Plates, etc. ...	721 15 0				
,, Balance Carried to Balance Sheet ...	7,533 7 0	8,255 6 0	,, Special Journal Fund		8,255 6 0
,, Expenses in Jodhpur Survey	2,887 10 9				
,, Balance Carried to Balance Sheet ...	616 7 3	3,504 2 0	,, Jodhpur Survey...		3,504 2 0

BOMBAY, *17th March, 1934.*

Examined and found correct.
(Sd.) A. F. FERGUSON & CO.
Chartered Accountants, Auditors.

A. FORRINGTON.
Honorary Treasurer.

PRINTED BY V. M. PHILIP AT THE DIOCESAN PRESS, MADRAS, AND PUBLISHED BY SIR REGINALD SPENCE FOR THE BOMBAY NATURAL HISTORY SOCIETY, BOMBAY

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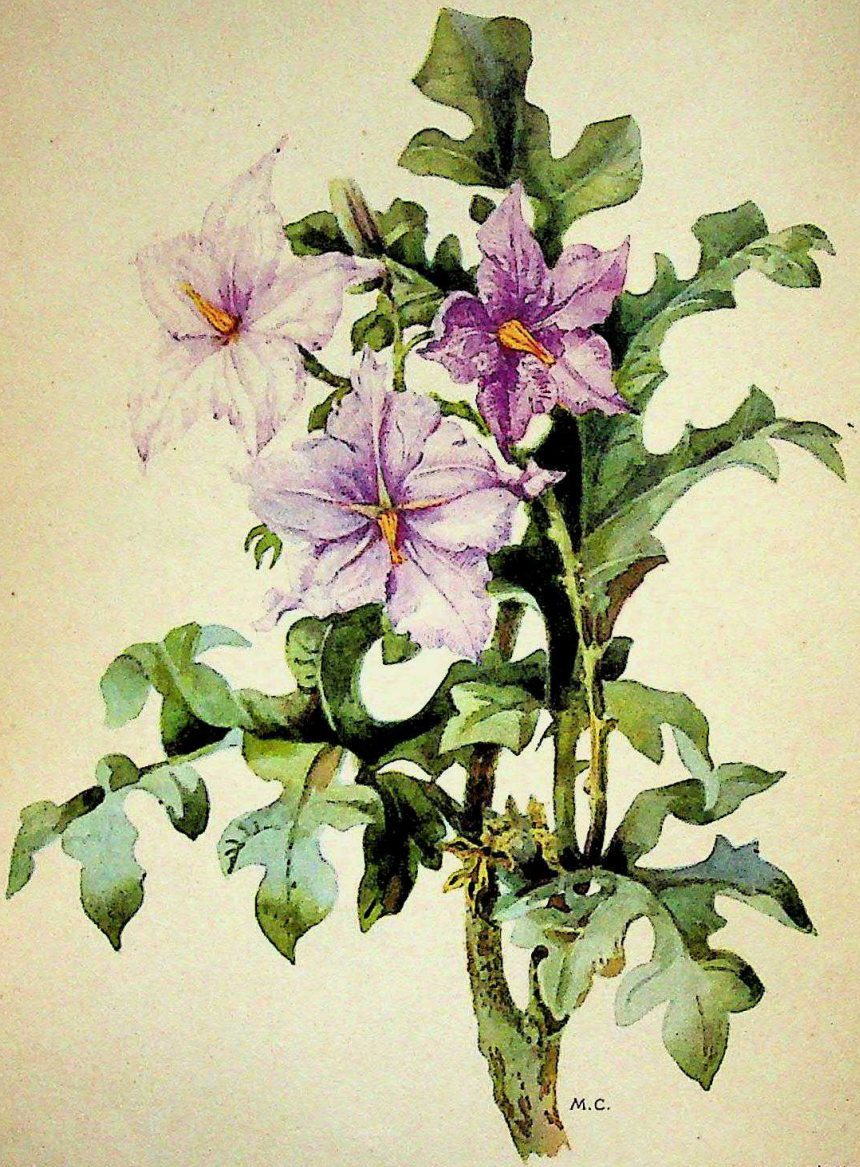

LARGE-FLOWERED NIGHTSHADE OR POTATO TREE.
Solanum macranthum, Dun.
(about ¾ nat. size)

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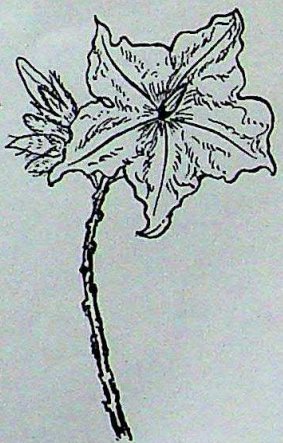
JOURNAL
OF THE
Bombay Natural History Society.

DECEMBER, 1934. VOL. XXXVII. No. 3.

GAME BIRDS OF THE INDIAN EMPIRE.

Mr. Stuart Baker's serial on the Waders and other Semi-Sporting Birds will be concluded in the next Number.—EDS.

Solanum macranthum Dun.—Belongs to the family *Solanaceae* of which the Potato is the best known representative. *Solanum* is from the Latin *Solatium* = Solace, because of the sedative properties which its several species exercise to lull pain. *Macranthum* from the Greek *makros* = large and *anthos* = flower, in reference to the size of the flowers.



Description: A shrub or small tree occasionally reaching a height of 30-40 ft. with yellowish brown straight prickles. Leaves large 10-15 in. long sometimes narrowing at the base forming a winged leafstalk. The leaf is slightly heart-shaped, egg-shaped, lance-shaped, or elliptically lance-shaped with deeply cut angles or lobes. It is paler beneath, covered with fine star-like hairs. The young leaves and shoots are densely covered with the same

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John Bale Sons & Danielsson Ltd London

LARGE-FLOWERED NIGHTSHADE OR POTATO TREE.

Solanum macranthum, Dun.

(about ¾ nat. size)

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JOURNAL
OF THE
Bombay Natural History Society.

DECEMBER, 1934. VOL. XXXVII. No. 3.

SOME BEAUTIFUL INDIAN TREES.

BY

THE LATE E. BLATTER, S.J., PH.D., F.L.S.,
and W. S. MILLARD, F.Z.S.

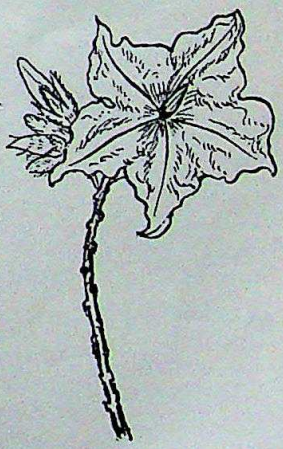
PART XVI.

(*With one coloured and one black-and-white plates and 2 text-figures*).

(*Continued from page 313 of this volume*).

THE LARGE-LEAFED NIGHT SHADE OR POTATO TREE.

Solanum macranthum Dun.—Belongs to the family *Solanaceae* of which the Potato is the best known representative. *Solanum* is from the Latin *Solatium* = Solace, because of the sedative properties which its several species exercise to lull pain. *Macranthum* from the Greek *makros* = large and *anthos* = flower, in reference to the size of the flowers.



Description: A shrub or small tree occasionally reaching a height of 30-40 ft. with yellowish brown straight prickles. Leaves large 10-15 in. long sometimes narrowing at the base forming a winged leafstalk. The leaf is slightly heart-shaped, egg-shaped, lance-shaped, or elliptically lance-shaped with deeply cut angles or lobes. It is paler beneath, covered with fine star-like hairs. The young leaves and shoots are densely covered with the same

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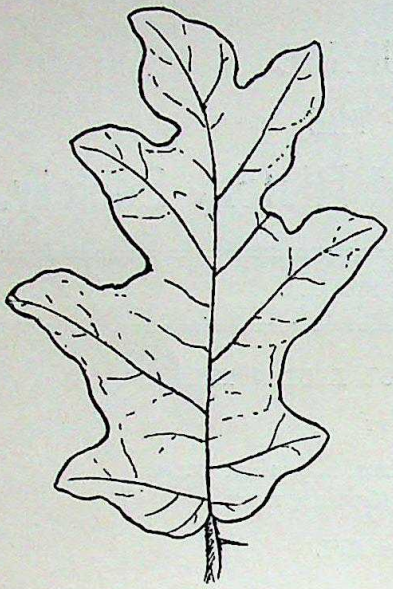
covering. The leaves on the undersurface are strongly armed with long prickles arranged at intervals along the nerves. The flowers are arranged in simple or branched bunches 3-5 in. long from 7-12 in number. The corolla is bluish-violet, 1½-2½ in. in diameter, the lobes are sharply pointed. The anthers are large and yellow. The fruit is almost rounded, the size of a golf ball.



Distribution: The Potato Tree is a native of Brazil.

Gardening: This plant is widely cultivated in gardens for its large showy flowers and beautiful leaves. It flowers the year round. It is easily propagated from seed or cuttings. Thrives best in sheltered and partially shaded situations, up to 3,000 ft. or higher if not exposed to strong winds. It was first introduced into Ceylon in 1844. This is probably the only species of the potato family that attains the form of a tree.

(To be continued).

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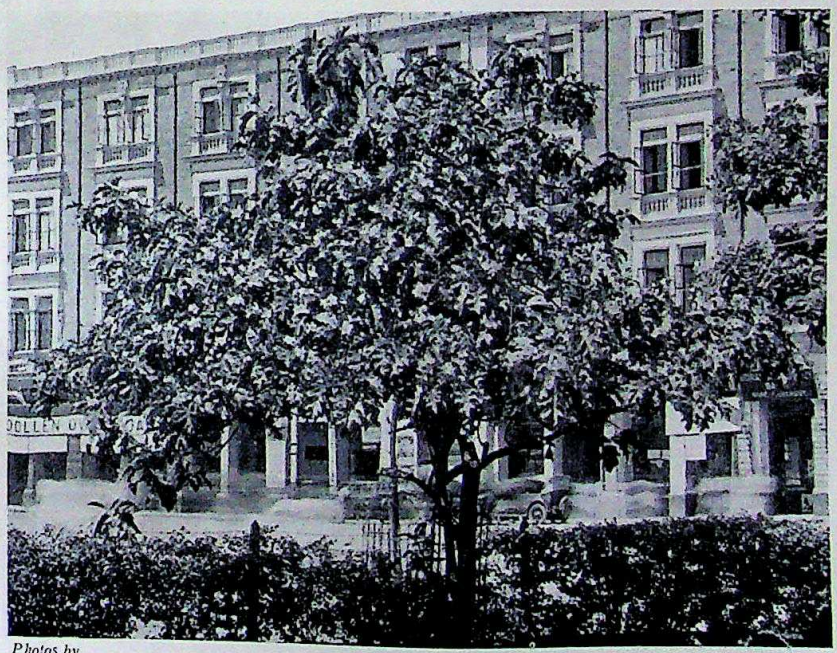
Flowers of the Large-flowered Nightshade or Potato Tree,
(*Solanum macranthum*, Dun.).



Photos by *H. N. Wandrekar.*

The Large-flowered Nightshade or Potato Tree
(*Solanum macranthum*, Dun.).

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THE VERNAY SCIENTIFIC SURVEY OF THE EASTERN GHATS.

(Ornithological Section).

BY

Hugh Whistler, M.B.O.U., assisted by N. B. Kinnear, M.B.O.U.

Part IX.[1]

(*Continued from page 297 of this volume*).

Thereiceryx zeylanicus zeylanicus (Gmel.).

Bucco zeylanicus Gmelin, Syst. Nat., vol. i, part. i (1788), p. 408—Ceylon.

The typical race of the Common Green Barbet extends to Travancore, where according to Ferguson, it is uncommon in the low country. He mentions shooting one as high as 4,000 ft.

According to Stuart Baker (Nidification, vol. iii, p. 326) Stewart took two nests in the extreme south of Travancore on 7th March.

Thereiceryx zeylanicus inornatus (Walden).

Megalaima inornata Walden, Ann. Mag. Nat. Hist., ser. 4, vol. v (March 1870), p. 219—Malabar (Coorg).

The account of the distribution of this race of the Common Green Barbet in the *New Fauna* (vol. iii, p. 111) is not at all easy to understand and there appears to be very little accurate information about its distribution in the Presidency where it is perhaps confined to the Western side. The British Museum contains the following specimens:—♂ 9 September 1882 Cannanore (Wardlaw-Ramsay); three birds 'Malabar' (Tweeddale Collection); two birds, including the type, Coorg (Waldan). It is said to breed in the Nilgiris in March (Rhodes Morgan), and according to Stuart Baker (Nidification, iii, p. 328) the eggs were obtained in the Nilgiris in April by both Col. H. R. Baker and General Betham. I have not, however, seen any skins from these hills and the species is not included by William Davison in his list of Nilgiri birds. There also seems to be no evidence for the statement (*New Fauna*, iv, p. 111) that this race occurs in Northern Travancore.

Thereiceryx zeylanicus caniceps (Franklin).

Bucco caniceps Franklin, P.Z.S. 1830-31 (October 25, 1831), p. 31—Between Calcutta and Benares and in the Vindhyan Hills between the latter place and Gurra Mundela.

Specimens collected:—1369 ♂ 10-2-30 Anantagiri 3,000 ft.; 1554 ♀ 16-3-30 Sankrametta 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	30·5	114·5	67·5	26 mm.
1 ♀	33	119	70·5	29 mm.

Franklin's race of the Common Green Barbet is recorded by Jerdon at Goomsoor and at Jeypore by Ball. A male collected by the latter on 23 March

[1] It is perhaps advisable to remark that this is the first part of the Eastern Ghats Survey to include the records from Mr. Stuart Baker's *Nidification of Birds of the Indian Empire*. The previous parts were written before the publication of the relevant volumes of Mr. Stuart Baker's book.

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1877 is in the British Museum. The above two survey specimens and a male in the British Museum, collected by Blanford north-east of Rajamundry on 29 May 1871 complete the records from this area.

Whether it occurs or not in the southern half of the east of the Presidency needs confirmation, both as to race and species. Roscoe Allen (J.B.N.H.S., xviii, p. 906) states that it breeds at Horsleykonda. Dewar says that he never saw or heard it personally at Madras, but that he had had it described to him. There is said to be a specimen in the Madras Museum, collected at Udayagiri.

The survey specimens agree with others from neighbouring areas in being small compared with birds from the Western Himalayas, though they agree with them in colour. Five males (Allahabad, Orissa, Vizagapatam, Hyderabad) measure:—bill 30·5-34, wing 112-117·5, tail 67-76 mm. Seven males from the Western Himalayas (Kangra to Gahrwal) measure:—bill 34-36·5, wing 121·5-129·5, tail 79·5-81 mm. The smaller bird is clearly Franklin's *Bucco caniceps* and I therefore propose for the other the name:—

Thereiceryx zeylanicus kangrae subsp. nov.

Type:—♂ Ranital 2,000 ft., Kangra 11 December 1921. Coll. H. Whistler No. 4042. British Museum register No. 1934.10.17.1.

Thereiceryx viridis Boddaert.

Bucco viridis Boddaert, Table Pl. Enlum. (1783), p. 53, based on Pl. Enlum. 870—India (Mahé).

Specimens collected:—204 ♀ 11-5-29, 240-241 ♀♀ 17-5-29 Shevaroy Hills 3,500-4,500 ft.; 383-384 ♂♀ 11-6-29 Chitteri range 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	25·5	102	66	26 mm.
4 ♀	25-27·5	102-109	61-67·5	25-27·5

La Personne reports that the Small Green Barbet was remarkably common and noisy on the Shevaroys, and in smaller numbers on the plains below. In the Shevaroys there seemed to be one in every tree. From the state of the organs it appears that the breeding season was well advanced in May.

This is an extension of the recorded range of this barbet which has hitherto been considered as confined to the West Coast. The *New Fauna* (iv, 114) gives its northern limit as Mahableshwar and the Deccan but Hayes Lloyd (S.F., i, 419) says that he obtained it in the Peint and Soorungun districts which border on the Khandeish Dangs, and James Davidson thought that he had seen it once or twice in the Satpuras (S.F., x, 298).

On the western side of the Presidency it is very common and well known. A specimen in the Hume collection was obtained at Mangalore and there are 4 specimens from Cannanore in the Wardlaw-Ramsay collection. Darling met it at Calicut (N. & E., ii, p. 326) and a specimen in Colonel Sparrow's collection was collected at Malappuram. In Coorg, the Wynaad and the Nilgiris, the Nelliampathies and Palnis and throughout Travancore it is extremely common at all elevations and there is no need to cite the records.

The breeding season in the Nilgiris, according to William Davison and Darling, extends from March until the first or second week of June; and those dates cover the records in the rest of our area except that Kinloch is said to have taken eggs in February in the Nelliampathies.

This Barbet undoubtedly increases in size from south to north. Of 8 specimens measured from Travancore, the largest has a wing of 104 mm., and all but three have wings under 100 mm. Ten specimens from Matheran, Khandala and Khandesh measure from 103 to 113 mm., specimens from other areas, however, obscure this distinction and at present I do not see any point in recognising two races.

Xantholaema haemacephala indica (Latham).

Bucco indicus Latham, Index Orn., vol. i (1790), p. 205—India.

Specimens collected:—466 ♂ 23-6-29 Tirthamalai 1,000 ft.; 506 ♀ 4-7-29

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Kalai; 714 ♀ 719 ♀ 20-8-29 Palkonda Hills; 752 ♂ 1-9-29, 803 ♀ 11-9-29 Kodur; 909-910 ♂♀ 12-10-29 Seschachalam Hills 2,000 ft.; 1164 ♂ 23-12-29 Cumbum Valley; 1343 ♂ 6-2-30, 1419 ♂ 21-2-30, 1761-1764 ♀ juv. ♂♀♂ 3-5-30 Anantagiri 3,000 ft.; 1726 ♂ 24-4-30, 1729 ♂ 26-4-30 Jeypore agency 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
10 ♂	17-18·5	77-83·5	34-36	17-19·5 mm.
6 ♀	17-19	74-81	33-35	17·5-19 mm.

The Crimson-breasted Barbet was found very commonly throughout the hill-tracts of Vizagapatam, as the list of specimens implies. Although there is no other record between that area and the Godavery Valley it is probably safe to assume that this species is a common resident throughout the whole of the eastern side of the Presidency. Dewar remarks on how he sometimes saw 70 or 80 birds collected in a single tree at Madras.

On the west it is very common in Coorg (Betts). It is sparingly distributed through the Wynaad and about the base of the Nilgiris (William Davison). I have seen specimens from the Segore and Kotagherry Ghats and Coonoor and these were probably all collected at low elevations. I have seen other specimens from Calicut (2 Hume collection), Pothanore (Hume collection) and Malappuram (Hume collection). In the Nelliampathies, according to Kinloch it does not occur. In the Palnis, Fairbank found it common at the base and up to 4,000 ft. In Travancore, it is said to be very common throughout the low country and at times on the hills up to 1,500 ft.

In the Vizagapatam hills, La Personne states that these Barbets were feeding young in the last week of April. In Travancore, they are said to lay in March.

In the *Ibis* 1919, pp. 219-22, Mr. Stuart Baker decided that there was only the one race of this Barbet in India, Ceylon and Burma but in the *New Fauna*, vol. iv, pp. 127-9, he changed his mind and recognised two races differing only in depth of colouration. The former opinion was right. The variation in tone and depth of colour in this species is partly individual but more largely due to the extent of wear. The survey series from Vizagapatam are in worn plumage and at first examination appeared to stand out markedly from the series obtained from south of the River Godavery as being olive greyish-green on the upper parts, very distinct from the more usual golden green colour of the worn plumage. I have, however, been able to match the Vizagapatam birds with others from the Nilgiris. Ceylon birds do not differ in size or colour from those of the main land.

Xantholaema rubricapilla malabarica (Blyth).

Bucco malabarica Blyth, J.A.S.B., vol. xvi (1847), pp. 386, 465—Malabar.

Not obtained by the Survey. The Crimson-throated Barbet is confined to the western coast of India from the Goa Frontier (Fairbank) to the south of Travancore. There is some doubt about its northern boundary. Fairbank recorded it from the Savantvadi Forests (S.F., iv, 255), but doubt was later thrown on the record (S.F., x, 423). Major Lloyd also included it as a Konkan species, but this was in turn doubted by Butler (S.F., ix, 387).

In the Presidency, William Davison says that it seems to be spread through the Wynaad and in some parts, as near Manantoddy, is comparatively common. There are specimens from Goodalore and Nellacotta in the Hume collection and there are 3 specimens collected by Wardlaw-Ramsay at Tellicherry in the Tweeddale collection.[1] It is very common in the Nelliampathies (Kinloch). In Tarvancore it is a rare forest bird in the hills, according to Ferguson, and he states that Bourdillon's account (S.F., iv, 392) is based on confusion with *X. haemacephala*. This fact must throw suspicion on the identity of the eggs collected by Bourdillon and described in N. & E., 2nd ed., vol. ii, p. 332 and mentioned by Stuart Baker (Nidification, vol. iii, p. 340).

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[1] I cannot trace the locality Chawachiraj from which there are six specimens in the British Museum collected by Wardlaw-Ramsay.

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The breeding season is in February and March according to the *New Fauna*, vol. iv, p. 130.

The Crimson-throated Barbet must in my opinion be considered a race of the Small Ceylon Barbet (*Xantholaema rubricapilla*). The latter differs from the former merely in having the supercilium, cheek, patch, chin and throat yellow instead of red, while the red patch on the lower throat is reduced in size. The relationship between red and yellow is well-known and the close connection between the two forms is shown in the juvenile plumage. The young of the two forms are not distinguishable, the traces of the red or yellow patches of the adult being yellow in both juveniles. A specimen of *X. haemacephala indica* in Col. Sparrow's collection from Muttra has the red of the head and breast replaced by yellow with slight traces of a red wash.

Cuculus canorus Linnaeus.

Cuculus canorus Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 110—Europe restricted to Sweden.

There is very little information about the Common Cuckoo in the Presidency though it evidently occurs. In Jaipur, Ball tells us (S.F., v, p. 414) that he not unfrequently heard a cuckoo in April which from its note must have been this species. La Personne says that in the Vizagapatam district in April it was calling and that it probably breeds at Sankrametta, but unfortunately none was obtained. Roscoe Allen heard it at Hosleykonda on 29 May (J.B.N.H.S., xviii, 905).

There is a specimen in the Government Museum at Madras which was killed in the neighbourhood though, according to Dewar, it only occurs on very rare occasions.

On the western side, Ferguson says that a specimen was shot at Trivandrum in February 1893. This bird has been obtained on two or three occasions in Ceylon.

As I have examined no specimen from the Presidency I am unable to discuss the question of the race which occurs.

[**Cuculus optatus** Gould.

Cuculus optatus Gould, P.Z.S. April 1845, p. 18—Port Essington, Northern Territory.

William Davison (S.F., x, 359) stated that the Himalayan Cuckoo was sparingly distributed in the Wynaad and that he had heard it calling late in May. This record has however been discredited by Blanford (P.Z.S. 1893, p. 318).]

Cuculus poliocephalus poliocephalus Latham.

Cuculus poliocephalus Latham, Index Orn., vol. i (1790), p. 214—India.

Specimen collected:—925 o? juv. 17-10-29 Seschachalam Hills 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
Sex? juv.	24.5	149	126	17 mm.

The Small Cuckoo is a winter visitor or passage migrant to the Presidency but we have very little definite information about it. On the eastern side Jerdon states that he procured it at Nellore (B. of I., i, 325) and the survey specimen provides the second specimen.

On the west the only records are furnished by a juvenile in the Society's collection obtained at Mercara, Coorg, on 20 October 1918 and a male in the British Museum, collected by Wardlaw-Ramsay at Cannanore on 7 September 1882.

It is commonly said to occur in the Nilgiris but I have not traced any evidence of the fact.

The fact that it is a passage migrant in large numbers through Dhulia (James Davidson, S.F., x, 299) from the middle of September to the middle of October suggests that it must be more numerous in the Presidency than the actual records indicate.

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Cuculus micropterus Gould.

Cuculus micropterus Gould, P.Z.S. December 5, 1837, p. 137—Himalayas, Simla.

Not met by the Survey. Very little is known about the Indian Cuckoo in the Presidency. Jerdon states (B. of I., vol. i, p. 327) that he had found it rare on the Malabar Coast and in the Carnatic. This tells us little and there is no more definite record for the eastern side, though two specimens in the Madras Museum are said to have been obtained locally. On the west William Davison says he found it occasionally in the Wynaad. There is a male in the Hume collection obtained at Coonoor on 28 July 1867. In Travancore Ferguson says that he never met with it in the hills but that it frequents forest in the low country and that its cry may be heard in April and May, especially towards dusk. The Trivandrum Museum then contained two specimens, shot in February and May. According to Stuart Baker (Nidification, iii, p. 317) an oviduct egg was obtained by Stewart in Travancore.

This southern bird appears to be identical with the Himalayan form, but there is not sufficient material to allow of a final decision on the point.

Hierococcyx sparverioides (Vigors).

Cuculus sparverioides Vigors in Gould Cent. Birds Himalayas 1831, plate 53—Himalayas.

The Large Hawk-Cuckoo has only been recorded from the Nilgiris so far as the Madras Presidency is concerned. There according to William Davison it frequents the Sholas and occasionally also well-wooded gardens. There are three specimens in the Hume collection viz., an unsexed and undated bird from Coonoor, a male dated 12 February 1881 from Ootacamund (Davison) and a female from Kotagherry collected by Miss Cockburn on 7 December 1874.

Its status in the Nilgiris is not very clear. Miss Cockburn communicated a long description to Hume (N. & E., vol. ii, p. 384) of two supposed nests found on April 11 and May 21 but these nests had evidently nothing to do with Hawk-Cuckoos though one was shot near the first of them.

Davison and Hume considered that these Nilgiri birds were smaller than the Himalayan breeding form but I have examined equally small birds from the Himalayas and can find no means of separating birds from the two areas.

Hierococcyx varius Vahl.

Hierococcyx varius Vahl, Skriv. Nat. Selsk. Kjöbenhavn, vol. iv (1797), pt. i, p. 61—Tranquebar, India.

Specimens collected:—78 ♀ 18-4-29, 143 ♂ 27-4-29 Kurumbapatti; 273 ♂ 23-5-29 Shevaroy Hills 4,000 ft.; 1039 ♂ imm. 25-11-29 Nallamalai range 2,500 ft.; 1629 ♀ 30-3-30 Sankrametta 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
3 ♂	26·5-27·5	190-195·5	162-166	24 mm.
2 ♀	27·5	188-194	152-166	23-24·5 mm.

The Common Hawk-Cuckoo seems to be widely, but by no means generally, distributed in the Presidency. In the extreme north-east Ball met it at Jeypore and La Personne obtained the above specimen at Sankrametta. Further south La Personne obtained it also in the Nallamalai Hills. About Madras it would seem to be scarce, as Dewar remarks that he only heard the well-known call once in eighteen months. In May and June the Survey found the Hawk-Cuckoo common in the Shevaroys and Chitteri Hills. They were calling late into the night and, when the moon was favourable, practically all night. Similarly at Kurumbapatti in April they were found to be common and were heard both by day and night.

On the western side of the Presidency, Betts considers it uncommon in Coorg and remarks that he never heard it calling there. He was of opinion that a young cuckoo which he saw being fed by Magpie-Robins was probably of this species. William Davison found the Hawk-Cuckoo plentiful throughout the Wynaad, and even more so on the slopes of the Nilgiris and on the

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plateau. There he noticed the nestling being fed by the Nilgiri Laughing-Thrush.

In the Nelliampathies according to Kinloch the bird does not occur. This seems curious as in the Palnis Fairbank found it common both at the base and on the hillsides, while in Travancore it is said to be abundant in the semi-cultivated land of the plains. It occasionally penetrates the jungles about the base of the hills up to about 1,000 ft. but Ferguson says he only met it once as high as 2,000 ft.

There seem to be no records about the breeding of this cuckoo in the Presidency beyond the implications of the above account and Stuart Baker's statement (Nidification, vol. iii, p. 349) that in South-west India most birds breed in May and June and in late April. Its actual status is not very clear though in the Nilgiris it seems to occur in most months. Baker says it is a resident species wherever found and that it is silent, and so not observed, out of the breeding season. Legge, however, says (Birds of Ceylon, p. 241) that it is extremely noisy at all times, even out of the breeding season and in Ceylon he considered it a migrant, arriving about the beginning of November. Wait, however, thinks that a few birds may be resident.

The only two specimens which I have been able to examine from Ceylon appeared to be darker than continental birds.

Cacomantis merulinus passerinus (Vahl).

Cuculus passerinus Vahl, Skriv. Nat. Selsk. Kjöbenhavn, vol. iv, pt. i (1797), p. 57—Tranquebar, India.

Specimens collected:—834 ♂ 19-9-29 Kodur; 936 ♂ 20-10-29 Seschachalam Hills 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	22	113	105·5-110	17-17·5 mm.

The Indian Plaintive Cuckoo has not been recorded definitely from that part of the Presidency north of Kodur and the Seschachalam Hills where it was obtained by the Survey. There is no other record from this side beyond an undated female, labelled Madras, in the Hume collection and Jerdon's general statement that it is rare in the Carnatic but found here and there in jungly places, and on the Eastern Ghats.

On the western side it occurs in fair numbers in the Wynaad and on the slopes of the Nilgiris at all elevations. The status here and in other parts of the Presidency is nowhere recorded but it is doubtless a resident in the Nilgiris as Miss Cockburn took a series of eggs from nests of *Prinia inornata* at Kotagherry from 17th to 26th September and found a nestling in a nest of the same foster-species on 5 October (Hume, N. & E., 2nd ed., vol. ii, p. 386). The Hume Collection contains skins from Kotagherry dated May, June and September as well as the above nestling killed on the 14th October. Specimens collected at Coonoor in April and September by Wardlaw-Ramsay are also in the British Museum.

In Travancore it appears to be rare. Ferguson only obtained two specimens shot in April in forest in the low country.

In the *New Fauna*, vol. iv, p. 155, Western Nepal is given as the western limit in the Himalayas. This is incorrect. It is comparatively common as a summer visitor to Simla (J.B.N.H.S., xxxii, 727) and it occurs in smaller numbers at Dharmsla (Ibis 1926, 749), at Murree (Rattray, J.B.N.H.S., xvi, 661) and Abbotabad (Currie, J.B.N.H.S., xxiv, 595). The account of the plumages is also quite misleading.

Cacomantis merulinus querulus Heine.

Cacomantis querulus Heine, Jour. für Orn. 1863, p. 352—Nepal.

Specimen collected;—1177 ♂ 26-12-29 Cumbum Valley.

Measurements:—

Bill.	Wing.	Tail.	Tarsus.
22	111	112·5	17·5 mm.

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The above specimen of the Burmese race of the Plaintive Cuckoo not only furnishes the only record for the Presidency but it also extends the range of the race in India. It has not previously been recorded south of Raipur, whence there are two males in the Hume collection dated January 1871 and 13 February 1871. The survey specimen is in adult plumage, except for some traces of the juvenile dress.

Penthoceryx sonneratii sonneratii Latham.

Penthoceryx sonneratii Latham, Index Orn., vol. i (1790), p. 215—India.

Not obtained by the Survey. The Banded Bay Cuckoo occurs in the Presidency in small numbers on the western side. There are specimens in the British Museum from Cannanore (♂ 9-9-82, Wardlaw-Ramsay) and the Wynaad (♂ 22-9-77, Darling) and four others from 'Malabar'. Jerdon and William Davison both say that it occurs on the slopes of the Nilgiris and the British Museum contains a specimen (♀ April 1878, Wardlaw-Ramsay) from Burliar, Coonoor Ghat and another (♂ 8-4-83, Davison) from Coonoor.

In Travancore Jerdon considered it tolerably common but Ferguson, on the other hand, called it decidedly rare.

On the eastern side of the Presidency the only record is Jerdon's statement that it is found more rarely in the Eastern Ghats and Mr. Roscoe Allen's mention of it at Horsleykonda in April (J.B.N.H.S., xviii, p. 905).

This cuckoo is apparently a resident in S.-W. India. In Hume's N. & E. (vol. ii, p. 382), it is stated that a broken egg was taken from the oviduct of a female shot on the Nilgiris on 19 May 1874. The authority for this statement is not given and the colour of the egg, pale bluish green, spotless, is at variance with the type of eggs that Mr. Stuart Baker believes to belong to this species. Other supposed eggs were taken in Coorg on 18th July (see J.B.N.H.S., xvii, 680).

Chalcites xanthorhynchus (Horsfield).

Cuculus xanthorhynchus Horsfield, Trans. Linn. Soc., vol. xiii, pt. 1 (May 1821), p. 179—Java.

Dr. Gravely kindly informs me that there is a male specimen of the Violet Cuckoo in the Madras Museum, collected at Perambur near Madras. This specimen does not appear to have been recorded.

Chalcites maculatus maculatus Gmelin.

Trogon maculatus Gmelin, Syst. Nat., vol. i, pt. i (1788), p. 404—Ceylon.

In Stray Feathers, vol. ix, p. 298, Mr. W. F. Dique records that 'on the 6th March 1878 a lovely male *Chrysococcyx maculatus* was caught with bird-lime in a garden at the Adyar, a few miles to the south of Madras. This specimen has the 'entire breast uniform emerald green'. This record of the Emerald Cuckoo was overlooked by the *New Fauna* and it is of especial interest not only in view of Jerdon's statement that 'it has been procured rarely in Central India', but with reference to the type locality.

Gmelin based his description of *Trogon maculatus* or the Spotted Curucui in the New Illustrations of Zoology of Peter Brown (p. 25, pl. xiii, fig. 2) published in 1776. In his introduction Brown tells us that a number of the 'plates are copied from the elegant Drawings, generously communicated to me by Gideon Loten Esq., and originally furnished under his own inspection from living subjects, during his residence in the Islands of Java and Ceylon of the latter of which he was Governor.' Loten was in the Dutch Colonial Service and held appointments in Java and Ceylon, in which latter place he served as Governor from 1752-57, and his original plates are in the British Museum. Seventeen of Loten's plates were used by Brown. Three of these are of Javan birds as stated by Brown and marked by Loten on the originals. Thirteen others are said by both Loten and Brown to represent birds from Ceylon. Of these ten can be identified for certain with species found in that island. Two others can only be doubtfully identified

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and a third (pl. xxxviii) called by Brown a Rail cannot be identified with any known species and Loten's original drawing does not help in any way. The remaining plate is of the Spotted Cuculi which is also stated by Brown to have come from Ceylon, but the original is missing so that we have no means of ascertaining what Loten actually said about the bird. This fact and the belief that the Emerald Cuckoo could not possibly occur in Ceylon has thrown doubt on Brown's type locality and an endeavour has been made to reject it. This in our opinion is unnecessary in view of the Madras record, for cuckoos are noted wanderers.

Surniculus lugubris lugubris (Horsfield).

Cuculus lugubris Horsfield, Trans. Linn. Soc., xiii (1820), p. 179—Java.

Not obtained by the Survey. The Drongo-Cuckoo is so far only recorded from the south of the Presidency and there it is mostly confined to the western side. A fine adult captured in the Museum compound at Madras on 14 October 1879 (Dique, S.F., ix, p. 298) provides the only record from the east.

Jerdon says that he procured it in the Wynaad. A male obtained in April 1878 on the Coonoor Ghat (Wardlaw-Ramsay) is in the British Museum. In South Travancore, according to Ferguson it is not uncommon, and probably resident, in the low country in open forest land.

According to Stuart Baker (Nidification, iii, p. 355) the breeding season in Travancore is from January to March and an egg believed to be of this species is described.

There has been some difference of opinion as to the race to which these South Indian and Ceylon birds are to be referred. Stresemann (Nov. Zool., xx, p. 340, et seq.) refers them to the typical race. Stuart Baker, however (Nov. Zool., xxvi, p. 293), considers them separable and provides them with the name of *S. l. stewarti*. I have been into the question carefully and can find no means of separating these birds from the typical race. There appears to be no difference in size, colour or wing-formula. *S. l. brachyura* of the Malay Peninsula has a much shorter and less deeply forked tail while *S. l. dicruroides* of the Himalayas is a larger bird.

Clamator jacobinus jacobinus (Boddaert).

Cuculus jacobinus Boddaert, Tabl. Pl. Enlum. (1783), p. 53 for Pl. Enlum., 872—Coromandel Coast.

Specimens collected:—95 ♀ 20-4-29, 105 ♂ 21-4-29, 127 ♂ 25-4-29, 155 ♂ 29-4-29 Kurumbapatti; 475 ♀ 23-6-29, 476 ♀ 24-6-29 Tirthamalai 1,000 ft.; 855 ♂ 30-9-29, 924 ♀ 17-10-29 Seschachalam Hills 2,000 ft.; 984 ♀ 8-11-29 Nallamalai range 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
4 ♂	24-27	141-146	157-165	25·5-27·5 mm.
5 ♀	25	140-146	155·5-161	25-27·5 mm.

The Pied Crested Cuckoo is not recorded in the Presidency north of the Nallamalai Range where the Survey obtained a specimen. In the Seschachalam Hills it was found to be common. In the Madras District, Capt. Bates informs me that it is by no means uncommon and that he has noted it in every month of the year. He also says that he saw it at Palmaner on 25 July. In Salem District, La Personne says that it was fairly well distributed throughout the plains area, preferably in the forested tracts, though it was not observed in the hills. It was common at Harur and Tirthamalai. At Kurumbapatti the birds were paired and very noisy by the first week in May, every part of the jungle seeming to have its own pair.

How far north this resident form occurs on the western side is not very clear, as the only specimen I have examined from the Nilgiris undoubtedly belongs to the migratory race. In Travancore, Ferguson says the Pied Crested Cuckoo is a resident and fairly common in the low country, more especially towards the extreme south. Jerdon found it breeding at Coimbatore. Davison

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records that while he had seen it only occasionally in the Wynaad it is common in the Nilgiris, being most numerous perhaps about cultivation round Ootacamund, Coonoor, Kotagherry and similar localities. On the western slopes, however, Mr. Betts informs me that it is scarce, occurring only at low elevations so it is possible that hereabouts we have the boundary between the two forms.

Rhodes Morgan considers the breeding season to be from about March to May and this agrees well with Capt. Bates' belief that about Madras it breeds in April and May. The female shot at Kurumbapatti on 20 April was laying eggs. Mr. Theobald, however, took an oviduct egg at Utnoor, Salem, as late as 18 August (N. & E., ii, 388).

An albinistic specimen from Madras is recorded (Dique, S.F., ix, 508).

In the *Journal* for September 1928 (vol. xxxiii, pp. 136-44) I attempted to enumerate and summarise the result of the records of this cuckoo in an endeavour to find the winter quarters of the huge numbers of Pied Crested Cuckoos which arrive to breed in the rains over a vast area of Northern and Central India. I then pointed out that only Southern and South-eastern India remained as a possible wintering place for these birds if they did not go to Africa. The former suggestion is now, I think, ruled out by the Survey which certainly never found this cuckoo in the numbers which one would expect if all the northern birds came south and only found the smaller race. To my mind there is now little doubt that the larger form winters in Africa.

The Survey has cleared up a further point. The original type locality of Boddaert's *Cuculus jacobinus* is the Coromandel Coast, that is the South-east coast of India from about the mouth of the Kistna to the Palk Straits. This area is inhabited not by the larger migrant form which has hitherto been considered the typical race but by the smaller resident bird which is identical with the resident Ceylon bird named *taprobanus* by Hartert [Nov. Zool., vol. xxii (1915), p. 254—Ceylon]. This is clear from the measurements. The complete series of Ceylon birds in the British Museum is as follows:—

	Bill.	Wing.
2 ♂	24-25	138·5-141
2 ♀	25-25·5	140·5-142·5
8 unsexed	25-25·5	138-143·5
Total variation 12 birds	24-25·5	138-143·5

A series of birds from N.-W. India (Kashmir, Punjab, United Provinces) measure:—

	Bill.	Wing.
12 ♂	25-28	146-155
8 ♀	24·5-28	144-151
Total variation 20 birds	24·5-28	144-155

There is no difference in plumage. Captain Bates has kindly sent me two birds (unsexed) from Madras to supplement the survey series. They measure:—bill 25-25·5, wing 140-142 mm. *Taprobanus* the name hitherto used for this form therefore becomes a synonym of the typical form. *Cuculus pica* Hempr. and Ehr., Symb. Phys. (1833), folio 2, note—type locality Ambukahl, Dongola appears to be the oldest name applicable to the larger northern bird which may in future, therefore, be known as *Clamator jacobinus pica* (Hempr. & Ehr.).

Clamator jacobinus pica (Hempr. & Ehr.).

Cuculus pica Hempr. & Ehr., Symb. Phys. (1833), folio 2, no , Ambukahl, Dongola.

As remarked under the last form this migratory race of the Pied Crested Cuckoo certainly occurs in the north-west corner of the Presidency. There is a male in the British Museum collected by Wardlaw-Ramsay on 23 August 1876 at Coonoor 6,000 ft. which has a bill of 25 mm. and wing of 152 mm. There is however nothing else to show whether the birds said by Davison to be common on the Nilgiris are resident or migratory or to which form they belong.

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Clamator coromandus (Linnaeus).

Cuculus coromandus Linnaeus, Syst. Nat., ed. xii, vol. i (1766), p. 171—Coromandel Coast.

The Red-winged Crested Cuckoo was not met by the Survey but it is probably a regular winter visitor and passage migrant in small numbers to the Presidency. Jerdon says that he had seen it in the Carnatic and there is a skin from 'Madras' in the Hume collection. Dewar says that he saw it in Guindy Park and that he also saw one in Colonel Carruther's aviary that had been caught in that officer's compound in Madras. A skin dated 1871 from Trichinopoly is in the Hume collection.

On the west William Davison mentions (S.F., x, 360) a report of one shot by a native taxidermist in the S.-E. Wynaad. Miss Cockburn sent Hume a specimen (now in the British Museum) shot at Kotagherry on 5 December 1874.

Ferguson mentions two winter specimens, then in the Trivandrum Museum, shot at 2,500 ft. and 4,000 ft. respectively on Ponmudi in 1892.

In Ceylon it is somewhat better known.

Eudynamys scolopaceus scolopaceus (Linnaeus).

Cuculus scolopaceus Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 111—Bengal.

Specimens collected:—326 ♂ 3-6-29, 411 ♂ 14-6-29 Chitteri Range 2,000-3,000 ft.; 708 ♀ 18-8-29 Palkonda Hills 1,000 ft.; 937 ♂ 20-10-29 Seschachalam Hills 2,000 ft.; 1207 ♀ 8-1-30 Godavery Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
3 ♂	29-30·5	187·5-193	186-195	32-35 mm.
2 ♀	29·5-31	194	190-192	30·5-31·5 mm.

There appears to be no record of the Common Koel in the Presidency north of the Godavery Delta where a female was procured by the Survey on a wooded island. This specimen is more fulvous than usual on the crown and throat but the bill is too small for *malayana* and it must certainly belong to the typical form as do Blanford's specimens from Badrachalam (♂ 17-2-71) and Rajamundry (♂ 30-5-71). Other specimens were collected in the Palkonda and Seschachalam Hills and at Madras the Koel is very common, according to Dewar. The Survey reported it common on the Shevaroys and plentiful on the Chitteri Range, frequenting both hill and plains forest in that area. Undated specimens from Arcot and Trichinopoly are in the British Museum.

In Coorg according to Betts the Koel is only a casual visitor. William Davison found them common and very noisy in the Wynaad in March and April, and also not uncommon about the lower slopes of the Nilgiris. He remarks that he once shot a pair at Ootacamund but their occurrence at that altitude is quite unusual. Specimens from Tellicherry (♂ 11-10-82 Wardlaw-Ramsay) and Calicut (January 1873 Hume collection) are also in the British Museum.

In the Nelliampathies according to Kinloch the bird does not occur. Fairbank, however, observed it a few times in the Palnis. In Travancore it is said to be resident but not very common, being found occasionally both in the hills and low country.

Mr. A. G. Cardew C. S. found various Koels' eggs in House-Crows' nests at Madras in the last week of June (N. & E., ii, 396). With this exception there are no breeding records for the Presidency and we have no accurate information as to its status though it appears to be resident.

Rhopodytes viridirostris (Jerdon).

Zanclostomus viridirostris Jerdon, Madr. Jour. Lit. Sci., vol. xi (1840), p. 223—Bottom of the Coonoor Pass.

Specimens collected:—58-59 ♂ ♀ 15-4-29 Kurumbapatti; 331 ♂ 5-6-29, 348 ♀ 6-6-29, 360 ♂ imm. 7-6-29, 370-371 ♂ ♂ 9-6-29, 404 ♂ imm. 14-6-29 Chitteri Range 2,000-3,000 ft.; 458 ♂ 21-6-29 Tirthamalai 1,000 ft.; 536 ♀ 8-7-29 Vyampatti, Trichinopoly; 674 ♂ 10-8-29 Palkonda Hills 1,000 ft.; 901 ♂

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11-10-29 Seschachalam Hills 2,000 ft.; 1042 o? 28-11-29 Nallamalai Range 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
7 ♂ ad.	29·5-32	132·5-138	207-235	32·5-35·5 mm.
2 ♂ juv.	29-30	128·5-130	212-215	33-34 mm.
3 ♀ ad.	29-32·5	129-139·5	218-228	32-34 mm.

There has always been some doubt as to the northern limits of the Small Green-billed Malkoha on the eastern side of India. Hume doubted Ball's statement that it occurred at Midnapore (S.F., vii, p. 207) while Jerdon's statement that it occurs as far north as Cuttack (B. of I., i, p. 347) was evidently only based on specimen 'A' in Blyth's Catalogue (p. 76) which was purchased in 1847. It certainly occurs, however, in Orissa for a female collected by Walton at Chamundia, Daspalla on 22 January 1902 is in the Society's collection.

The most northern record for the Presidency is Blanford's specimen in the British Museum collected north of Ellore (♀ 5-4-1871). South of the Godavery it appears to be fairly general and common down to the Cauvery River, south of which I have no information beyond the fact that it occurs on Rameswaram Island (S.F., iv, 458). In Cuddapah District La Personne says that it is common in bamboo and other forests. In Salem District he found it extremely common from the foot of the Shevaroys to Tirthamalai both in the hill and plains forests. Captain Bates informs me that it is not uncommon in the Reserved forests round the groups of isolated hills near Madras, there being apparently a pair to every hill. He adds the following note:—they seem very attached to certain localities and on revisiting certain hills at considerable intervals of time, I have almost always succeeded in finding the birds within a hundred yards or so of where they were first noted. They are skulkers with much the same habits as the Crow-Pheasant, though I have never seen one actually on the ground. When caught in the open they often 'freeze', sometimes in the most grotesque attitudes, hoping thereby to escape detection.

This Malkoha is also fairly common on the western side of the Presidency. There are two specimens from Calicut in the Hume collection. William Davison says that it does not ascend the hills but occurs, though never very numerously, in the better wooded parts of the Wynaad and the country about the base of the Nilgiris. A specimen in the British Museum was, however, killed as high as 3,000 ft. on the Coonoor Ghat. Jerdon mentions its partiality for the large hedges of *Euphorbia* in the Coimbatore District. Colonel Sparrow informs me that it occurs near Malappuram. Fairbank met with 4 in all in thickets at the eastern base of the Palnis. In Travancore Ferguson says it is not uncommon about the base of the hills in open forest and he shot it as high as 3,000 ft. at Pirmade.

As to the breeding season Mr. A. G. Cardew obtained 2 eggs from a nest near Wandiwash (North Arcot) on 10 March (Hume, N. & E., ii, p. 399). La Personne considered that they were breeding at Kurumbapatti in April and in the Shevaroy-Tirthamalai area in May and June. A fledged young bird was seen at Chitteri on 23 June. This appears late however, as the above series contains young birds in post-juvenal moult in June.

The only variation that I can find in specimens of this Malkoha from India and Ceylon lies in the white tips to the tail feathers. In specimens from Ceylon these tips are very deep and in some cases the ends of the shorter feathers almost touch the bases of the white tips of the next in the series, so that the sides of the tail appear white from below. In 15 specimens the tips of the second tail feathers (counting from the outside and measuring the greatest length of white which is on the outer web) vary in depth from 35 to 51 millimetres. In the third tail-feather the variation is from 33.5 to 50 mm. In a small series from South Konkan the white tips are much narrower, the corresponding measurements being 33 to 37 and 28.5 to 37.5 mm. There is, however, such complete intergradation between these two extremes from south to north and the difference at best is so small, that there is no reason to recognise two races.

It does, however, appear probable that *viridirostris* should itself be grouped with other members of the genus as subspecies of one widely distributed species,

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but I am unwilling to suggest such an arrangement without further study of the group as a whole.

Phoenicophaus pyrrhocephalus (Pennant).

Cuculus pyrrhocephalus Pennant, Ind. Zool. (1769), p. 16, pl. vi—Ceylon.

According to Stuart Baker (*New Fauna*, iii, p. 182 and Nidification, vol. iii, p. 364) the Red-faced Malkoha, which has hitherto been recorded as peculiar to Ceylon, occurs in the extreme south of Travancore where Mr. Stewart is said to have taken eggs in April and May.

Taccocua leschenaultii leschenaultii Lesson.

Taccocua leschenaultii Lesson, Traite' d' Orn. (9 May 1830), p. 144—India, now restricted to Madras.

Specimens collected:—768 ♀ 28-8-29 Palkonda Hills 1,000 ft.; 858 ♂ 1-10-29 Seschachalam Hills 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	30·5	154	229·5	43·5 mm.
1 ♀	29·5	148	211	45 mm.

The Sirkeer Cuckoo appears to be scarce throughout the Presidency. The only records of this form on the eastern side, other than Jerdon's general remark that he had procured it on the Eastern Ghats, are furnished by the above two survey specimens.

On the western side the Sirkeer is found but is rare on the Nilgiris. Jerdon and William Davison both record that they met it up to 5,000-6,000 ft. elevation. Miss Cockburn considered it was confined to the lower slopes. A specimen collected by her near Kotagherry on 23 September 1874 is in the British Museum.

In Travancore Ferguson says that he met it once only, in the low country. There is one 'Anjango' specimen in the British Museum.

The only hint of the breeding season in our area is furnished by Miss Cockburn's statement that the only nest she ever found contained 2 eggs in March.

In the J.B.N.H.S., vol. xxviii, p. 158, Mr. Stuart Baker restricted the type locality of *leschenaultii* to Kanara, Bombay, an unfortunate choice as that is an area where the birds are intermediate in character between *leschenaultii* and *sirkee*. It cannot however be considered correct as Lesson received his specimen from the French Traveller M. Leschenault de la Tour who visited India in 1816 remaining some time at Pondicherry and then travelling up the line of Eastern Ghats to Bengal from where he went to Ceylon and then France. However in the *New Fauna*, vol. vii, p. 337, Stuart Baker has dropped his restriction and says that 'India' may be considered as equal to Madras and to that district I now restrict it, as it lies within the sphere of M. Leschenault's activities.

It may also be noted that Stuart Baker is clearly wrong in placing Blyth's *Taccocua infuscata* in the North-Western Himalayas. In his footnote to p. 187 Baker presumes that Blyth must be referring to the West Himalayan bird because 'he describes his bird as pale and large' and again because in later describing *affinis* from Bengal he 'lays stress on the dark plumage'. A reference to the original descriptions removes these difficulties. Blyth did not describe the bird as pale and large but speaks of the 'larger size and infuscated colouring', a very different matter and in agreement with the darker colouration that he proceeds to elaborate; while in describing *affinis* he says it 'combines the size of *Taccocua sirkee* with the colouring of *Taccocua infuscata*', that is to say he does not attempt, as Stuart Baker implies, to distinguish between the colouration of the two forms. As a matter of fact there need have been no doubt in the matter at all, as Ticehurst points out (J.B.N.H.S., xxxiv, 471), for Blyth's type specimen came from the Terai region near Darjeeling. I cannot, moreover, substantiate the wing limit of 186 mm. as given by Stuart Baker and suggest that this is a misprint for 168 mm.

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Taccocua leschenaultii affinis Blyth.

Taccocua affinis Blyth, J.A.S.B., vol. xv (1846), p. 19—Rajmahal.
Specimen collected:—1534 ♂ 13-3-30 Sankrametta 3,500 ft.

Measurements:—

Bill.	Wing.	Tail.	Tarsus.
31·5	153·5	233	46·5 mm.

The single specimen of the Sirkeer Cuckoo met and collected by the Survey in the Vizagapatam Hills can certainly not be attributed to the typical race as it stands out markedly from the other specimens by the richness of its colouration which is much darker both above and below, in this agreeing with the East Himalayan form *T. l. infuscata*. It agrees with a number of other birds in the British Museum from neighbouring areas, Muddapur, Maunbhum, Palamow, Hazaribagh, Sambalpur, Raipur and Badrachalam and a series of fifteen such birds measure:—bill 31.5-33, wing 148-158 mm. This is noticeably smaller than true *T. l. infuscata* of which I measured four specimens from the Eastern Terai:—bill 34-35, wing 160-163 mm., and the series evidently belong to the intermediate form which Blyth named from the Rajmahal Hills and Monghyr as being the same colour as *infuscata* but smaller. It is not perhaps a very good race but it may be recognised. Mr. Stuart Baker's error in placing the type locality of *T. l. infuscata* in the Western Himalayas has led him to include the East Himalayan bird with these intermediates under the name *affinis*, but if it is considered desirable to keep them together the name *infuscata* (1845 after July) will of course take precedence.

Ball's record (S.F., vii, 208) of the Sirkeer from Jeypore is the only other record of this form in the Presidency.

Centropus sinensis parroti Stresemann.

Centropus sinensis parroti Stresemann, Nov. Zool., vol. xx (1913), p. 323—Ceylon.

Specimens collected:—124 ♂ 24-4-29 Kurumbapatti; 266 ♂ 22-5-29, 283 ♂ 25-5-29 Shevaroy Hills; 341 ♂ 6-6-29, 363 ♀ 8-5-29, 378-380 ♂♂♂ 11-6-29 Chitteri Range 2,000-3,000 ft.; 682 ♂ 12-8-29 Palkonda Hills 500 ft.; 814 [♀] 13-9-29 Kodur 500 ft.; 1376 ♂ 12-2-30 Anantagiri 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
9 ♂	37-40.5	176-194	220-251	42-51 mm.
2 ♀	38-41.5	183-199	223-256	49-51.5 mm.

The Common Crow-Pheasant seems to be a common and generally distributed resident species in the Presidency, though on the eastern side there is no definite record for the area between Anantagiri, where a specimen was procured by the Survey, and Madras. About the latter city Dewar tells us it is common, one to be seen in almost every garden of any size. The Survey specimens complete the records on this side save for a specimen in the Society's collection collected by Mr. Prater at Madura in May 1917. La Personne comments on the grotesqueness of the display and its lack of harmony of movement or appropriateness of sound. A step forward and one sideways and then a backward strut, accompanied by some hideous sound that might be either a croak or an oath!

On the west it is very common everywhere in Coorg (Betts) in the Wynaad (William Davison) and all over the Nilgiris, more plentiful on the slopes and less numerous on the plateau (Davison and Betts). In the Nelliampathies, however, Kinloch considered it merely an occasional straggler to the northern slopes in the hot weather, though Fairbank observed it up to 5,500 ft. in the Palnis. In Travancore it is very abundant in the low country and about the foot of the hills (Ferguson). There is a good series of skins from these areas in the British Museum.

In the Nilgiris Miss Cockburn considered the breeding season to be in March and April (N. & E., ii, 403) and Betts found nests at 6,500 ft. in April and August. In Travancore Ferguson found eggs in June and August. Mr. Cardew found a nest with eggs just ready to be hatched on 9 March and another with one fresh egg on 20 July. This was at Madras.

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All Presidency birds belong to the race *parroti* which was described from Ceylon. The *New Fauna* (vol. iv, p. 189) lays emphasis on the colours of the under wing-coverts and inter-scapulary area in the keys to the species and subspecies. This requires a word of caution. Of twelve specimens of *parroti* that lie before me at the moment nine show a greater or less amount of chestnut on the under wing-coverts, in face of the statement in the key that the under wing-coverts of this species are never chestnut. As regards the inter-scapulars, this is a feature which is not easy to assess; if the scapulars are parted there is in some birds a distinct but narrow band of chestnut joining them; in others there is as clearly no such band, the black of the hind neck and rump being uninterrupted. These birds follow the subspecific key well enough. But there are in addition a number of specimens which one would hesitate to assign clearly to either group, for the character is one which is affected by make of skin and sit of the feathers and there is much intergrading between the two extremes.

The brownish colour of crown, chin and throat in many specimens appears to be largely due to wear. The sooty wash on the coverts and inner secondaries and tertiaries found in some specimens is due to individual variation, but it appears to be to some extent subspecific in character, in that it is more frequently found in *parroti* than in *sinensis*.

Attention needs to be paid to the question of juvenile plumage in this species. Some young birds are similar to the adult, others wear a barred plumage, and this may also be of subspecific significance, but I have not seen sufficient specimens to settle the point.

Centropus benghalensis (Gmel.) subsp.?

Cuculus benghalensis Gmelin, Syst. Nat., vol. i, pt. i (1788), p. 412—Bengal.

The Lesser Coucal is confined to the western side of the Presidency and even there it must be very local. William Davison says that he met with it on some half-dozen occasions in the Wynaad, always in long grass.

In Travancore Ferguson says it is not uncommon in the hills, where also it frequents grassland.

There are six specimens in the British Museum, all said to have come from Peermade. They lack precise data and all appear to be females. In the absence of a better series I am unable to elucidate the question of the exact race of this species which occurs in the presidency. The plumage stages are complicated and difficult to understand and they must certainly be fully worked out before the races of this species can be properly elucidated as the bird has a wide range towards South-East Asia. I am, however, satisfied that these Travancore birds do not belong to the typical race, to which they are attributed in the *New Fauna*.

Nothing seems to have been recorded about the breeding in the Presidency.

(*To be continued*).

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A herd of Bison (*Bibos gaurus*, H. Sm.) grazing in sparse jungle.

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IN AMBUSH FOR BISON.[1]

(A Big Game Photographer's Fortune and Misfortune in Burma.)

BY

E. H. PEACOCK.

(*With 3 plates*).

If my memory is not at fault, Major Evans in his book: *Big Game Shooting in Upper Burma,* mentions having seen a herd of a hundred bison on the *lwins* (grassy plains) north of Homalin in the Upper Chindwin District, several years ago. This must have been a momentous sight, but very likely it was due to a temporary gathering of two or more bison herds.

When the new grass has begun to sprout after the annual ground fires of March and April, bison will habitually frequent suitably remote *lwins*, and, if undisturbed, will feed greedily every morning and evening on the tender grass shoots. At such times small herds will often amalgamate to form large ones.

Ordinarily, a collection of 20 bison would be considered a fairly large herd, but I have seen much greater herds on many a lonely *lwin* in the northern drainages of the Irrawaddy and Chindwin rivers.

I recollect having seen, about ten years ago, an immense herd of bison on one of the many fine *lwins* that lie between the great Indaw Lake and Shwedwin Village on the Uyu river. I counted over 50 animals in this herd, but there must have been about 60 all told, if not more. Some of the *lwins* in this region are immense plains of short *thekhe* grass interspersed with patches and belts of woods. At that time villages were few and far between, and the game lived out on the *lwins* for much of the dry season and the early rains. What glorious country that was for a sanctuary and ultimately, perhaps, a game park.

The two principal sanctuaries in Upper Burma are so small that one might walk across either of them in less than a day; yet they can show during May and June, when the herds from the surrounding forests gather and amalgamate on the *lwins*, collections of bison numbering 50 or more.

The photograph at the head of the opposite page shows 29 animals, but the herd of which they were a part consisted of 45 bison, including calves—a sufficiently impressive sight. The members of this herd were so spread out that it was impossible to include them all on one negative. On this occasion the wind persisted in the right direction and the whole herd walked, figuratively, over the bushes behind which I was concealed; but, in the failing light, as they drew near to me, their movements blurred the images obtained from the time exposures I was obliged to make, and when they detected me they galloped away.

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One is so annoyingly at the mercy of one's subject in this branch of photography: not in any physical sense, I hasten to aver, because the 'dangers and difficulties' of animal photography as opposed to big game shooting have been so much overdone, that I would not unwittingly support the fallacy. One really fine old bison, fairly sought, tracked and shot under good game laws, is likely, especially when wounded, to create more difficulty and thrills than the photography of a dozen assorted groups on *lwins*, at 'licks' and waterholes, and from the backs of elephants; which is a fact too easily misunderstood or hidden from the photographer who is not also a hunter.

The young bison calves always strike one as being remarkably foreign to their parents; their light brown, sometimes fawn-coloured coats are much opposed to the black bodies of the mature animals. They are funny, ungainly-looking things when very young.

In 1920, while hunting in the Kyauklebin forests of the Ruby Mines District with the local guides, Maung Naing and Maung Ba, I met a young bison calf that had become separated from its relations. With the wind behind him, this young bull walked right up and studied us from within 10 ft. with the greatest curiosity and no atom of fear; yet, when we circled round him and he smelt the taint of human presence, he at once galloped off with every sign of fear and unease.

It is interesting when examining the enlarged image of such a group as that shown opposite to remark features that have not been observed in life; for instance, plate II shows a cow with one perfectly straight horn, but the other curved in the usual way. I failed to observe this feature at the time of making the exposures.

One photograph provided some mild thrills. I had worked myself into position, in breast-high grass, directly in front of the herd, just as it was about to emerge from the forest. It was very late in the evening, and, with a moderate aperture, I was obliged to make exposures varying from two to five seconds, depending on the degree of mobility in the herd at the time of making the exposures. The camera-tripod and much of myself were, of necessity, well clear of the grass, and I was soon detected.

A young bull saw me first, and complicated matters by moving out of the picture and trotting up within 20 yds. on my right front, where he stamped and snorted in company with a curious-minded cow which had followed him. I remained perfectly still, which puzzled him; but when I moved gently in focusing and photographing the main herd, the young brute stampeded back to his companions and set them all snorting and staring. Nevertheless, they continued to advance slowly in a closely packed line, some tossing their heads and staring curiously, others quite placid and obviously of opinion that it was merely another instance of 'that young fool's false alarms!'

The forester who was crouched behind me became nervous, and whispered excitedly: 'They'll think we are tigers. They'll ring us round and charge.' Of course, they were unlikely to do anything of the sort, and in due course, when I grew over-anxious to get a picture from well above the level of the high grass, some intelligent

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Part of a herd of Bison (*Bibos gaurus*, H. Sm.) grazing on a small *lwin* or plain.

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A herd of Bison (*Bibos gaurus*, H. Sm.) on the edge of the forest.

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elders of the herd made out that I was a man; whereupon the herd departed, and did not dwell on the order of its going.

Bison rest or sleep in heavy cover between, roughly, 10 o'clock and 3 o'clock in the daytime, and seldom come out of cover until the light has definitely begun to fade or until it has become quite dark. When they feel secure, however, they may lie up in light forests, or move through thin forests on their way to the grazing grounds while the sun is still high above the horizon.

The herd shown in my first photograph was behaving in just such an unbisonlike manner, so, thinking I had plenty of time, I contented myself with a couple of long range photographs, and delayed a nearer approach till it should reach a more easily-stalked position. Unfortunately, this herd moved off into heavy forest through which I must track it for a mile or more till it emerged into a most beautiful little *lwin*, where it settled down to serious grazing.

The setting of this *lwin* and the bison, on the slope of a hill with dark woods on one side and hills and clouds for background, was so fine that I hurried my stalk and was detected before I had got my camera clear of the tangle of weeds and grass through which I was crawling. This was a most exasperating moment: the bison, about 20 of them, had bunched together in alarm and presented a fascinating group in a splendid setting within easy camera range; but I was confined to shoulder-high grass, and the tripod, at its highest, would not raise the camera lens above the top of the grass, neither would the light permit of an instantaneous exposure with the camera held high in my hands.

I tried to move into a better position, but it was quite hopeless; and, after staring and snorting for a good ten seconds, these most unsatisfactory camera-subjects presented me with a last sight of their tails as they disappeared into the forest.

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REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY.

BY

THE LATE E. BLATTER, S.J., PH.D., F.L.S.

PART XXV.

(*Continued from page 277 of this volume*).

CYPERACEAE

BY

THE LATE E. BLATTER, S.J., PH.D., F.L.S., and C. MCCANN, F.L.S.

(*With 4 plates and 1 text photo*).

5. MARISCUS Vahl (Cke. under *Cyperus*).

Erect herbs, usually perennial and glabrous; generally resembling the genus *Cyperus*. Inflorescence of a single head or in simple or compound umbels. Spikelets usually in compact compressed or terete heads. Glumes distichous, persistent on the rhachilla which disarticulates above the 2 lowest (which are empty and smaller than the rest) leaving a small knob or disk with, sometimes, an annular ridge on its summit. Stamens usually 3. Style 3-fid, continuous with the ovary; stigmas slender. Nut trigonous.—Species about 50. —Cosmopolitan.

A. Base of stem oblong, thickened by the turgid membranous sheaths	
I. Stolons 0	1. *M. Blatteri.*
II. Stolons slender	2. *M. bulbosus.*
B. Base of stem not thickened by sheaths. Stem tall, or when short, thin slender. Spikelets narrow, not turgid, pale, bearing 1-3, rarely 4, nuts	3. *M. paniceus.*
C. A much larger and coarser plant than B. Umbel large, rays up to 17 cm. Spikes digitate on the rays. Spikelets fewer and more distant, subsecund, larger, 9 mm. ...	4. *M. konkanensis.*
D. Stem tall. Spikelets pale, turgid, bearing several nuts	5. *M. pennatus.*
E. Stem tall, robust. Umbel large, spreading. Spikelets innumerable in globose spikes, very narrow, almost filiform, golden red ...	6. *M. compactus.*

1. **Mariscus Blatteri** McCann, *sp. nov.*

[*Pertinet ad sectionem Marisci bulbocaulis. Accedit ad Mariscum dregeanum* Kunth *a quo tamen distingui potest culmo usque ad 70 cm. longo, foliis culmo brevioribus vel longioribus (usque ad 88 cm.) 6 mm. latis, acumine acuminatissimo, margine et venis in facie superiore scabris, marginibus minutim serrulatis, inflorescentia multo maiore (24×19 mm.), bracteis usque ad 9, infima 34.5 cm.×6 mm. attingente, spicula multo longiore duas continente nuces, squama sterili superiore ad apicem biloba cum arista longa vel brevi in sinu, rhachilla alis oblique oblongis munita, staminibus 3, nuce quam gluma aliquantulum breviore.*]

Description: Stolons 0. Roots numerous, fibrous, dark brown. Stems tufted, at base, broadly ovoid, thickened by the light brown leaf-sheaths, up

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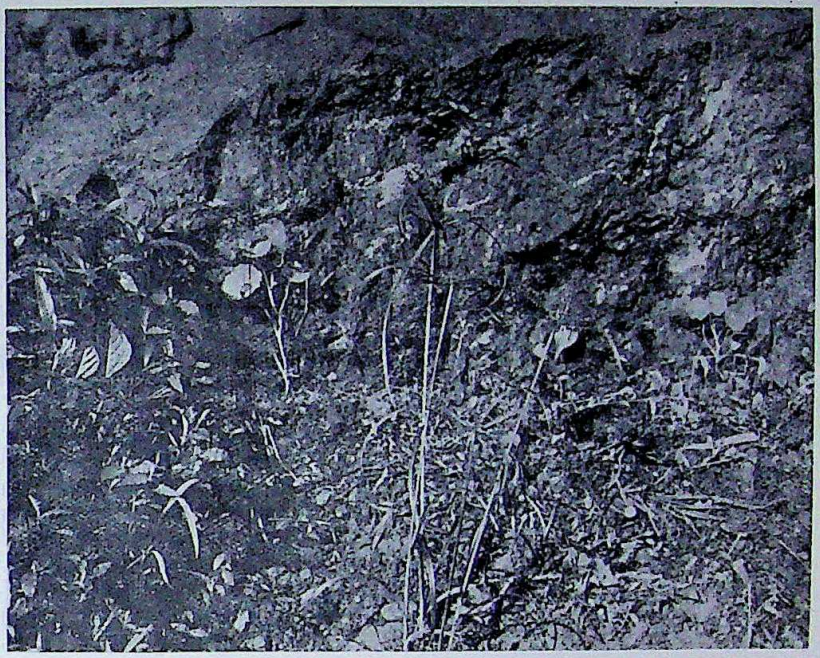
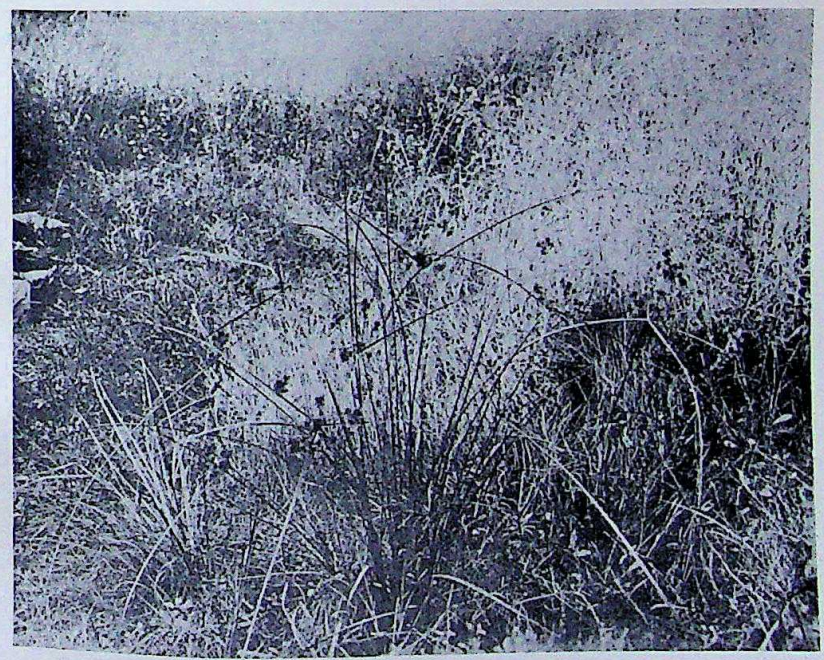


Mariscus paniceus. Vahl at Panchgani.



Mariscus compactus Druce, near Malad, Salsette Island.

Photos by C. McCann.

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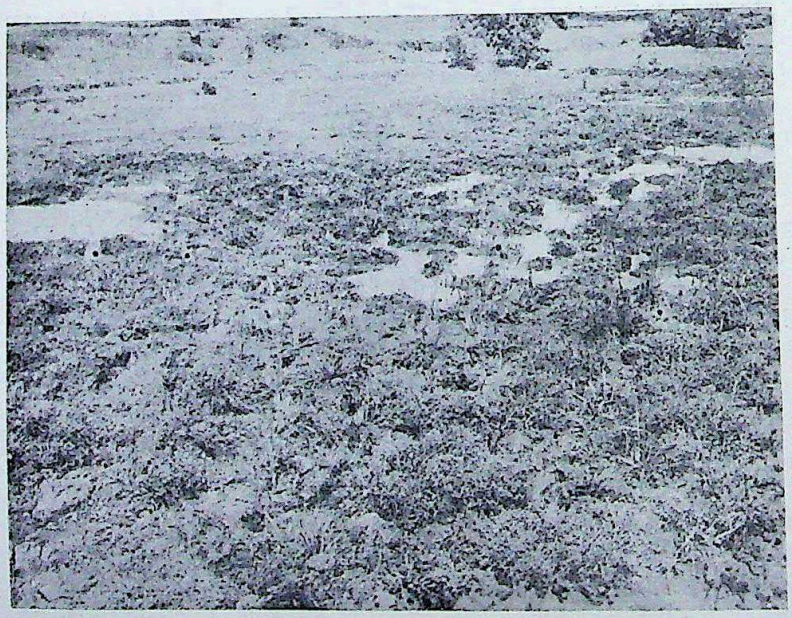
Fimbristylis tetragona R. Br. growing in a marsh at Mulland, Salsette Island.



A formation of *Fimbristylis aestivalis* Vahl and *F. dichotoma* Vahl growing in a marsh at Khandala, W. Ghats.

Photos by C. McCann.

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to 70 cm. long, slender, trigonous, smooth (striate in dry specimens). Leaves as long as the stem or longer reaching 88 cm. by 6 mm., weak, grass-like, tips finely acuminate, margins and veins of upper surface scabrous, the margins minutely serrulate, presenting a sharp cutting edge. Inflorescence 24 by 19 mm. appearing as one very dense head of numerous spikelets as if composed of 3 congested spikes, slightly reddish in colour. Bracts up to 9 (some appearing from within the inflorescence) similar to the leaves spreading and ultimately drooping, lowest 34.5 cm. by 6 mm., upper portion scabrous along the veins, margins serrulate like the leaves, tips finely acuminate. Spikelets 8 mm. long by 1.7 mm., angular, bearing 2 nuts, disarticulating below the lowest fertile flower in one piece. Glumes all with red glandular dots; the lowest empty glume broadly elliptic, 7-nerved, 2 by 1.5 mm., tip rounded, margins membranous, incurved in the lower half; upper empty glume ovate-lanceolate, 9-nerved, 3 mm. long (including the arista), tip bilobed with a short or long arista in the sinus, margins incurved, membranous; lowest flowering glume larger than the one above it, ovate-lanceolate, acute, 13-nerved, 6 by 2.6 mm. (opened out), margins membranous, incurved over the wings of the rhachilla; upper flowering glume elliptic-lanceolate, 13-nerved, 4.5 by 2.5 mm., tip produced into a short recurved point, margins membranous, incurved over the wings of the rhachilla. Rhachilla broadly winged, the wings together elliptic, but individually obliquely oblong, tip oblique running into the margin of the glume above, embracing the nut. Stamens 3, filaments strap-shaped, anthers oblong, not crested. Nut oblong, trigonous, puncticulate, reaching 3.5 by 1.3 mm., base of style sometimes persistent. Style, including branches, 5 mm., branches 3 mm. long.

Locality: *W. Ghats*: Mahableshwar (Nana Sedgwick's Coll. 7646 ! type).

2. **Mariscus bulbosus** C. B. Clarke in Hook. f. F.B.I. vi (1893) 620.—*Cyperus Clarkei* T. Cooke in Fl. Bomb. ii, 873.—*Kyllinga bulbosa* Koenig in Vahl Enum. ii (1806) 376 (*in nota*).

Description: Cke. l.c.

Locality: *S. M. Country*: (Woodrow 36 ex Cooke); Dharwar (Woodrow ex Cooke, Talbot 2907 !), on dry pasture, 2,400 ft., rainfall 34 in. (Sedgwick 4140 ! 6233 !); Badami (Woodrow ex Cooke).—*N. Kanara*: (Young ex Clarke).

Flowering & fruiting: August 1918 and October 1892 (Dharwar).

Distribution: S. M. Country, N. Kanara, Horsleykonda, Chingleput, Salem, Tinnevelly Dist.

3. **Mariscus paniceus** Vahl Enum. ii (1806) 373.—*Kyllinga panicea* Rottb. Descr. *et* Ic. (1773) 15, t. 4, fig. 1.—*Mariscus cyperinus* Vahl l.c. 377; C. B. Clarke in Hook. f. F.B.I. vi, 621.—*M. Sieberianus* Nees in Linnaea ix (1835) 286.—For synonyms see C. B. Clarke l.c. 620, 621, 622.

Description: Base of stem not thickened by sheaths. Roots producing stolons or not. Stolons long, scaly. Rhizome very short, nodulose, or thick, creeping, clothed in the remains of old leaf-sheaths. Stems 5-75 cm. high. Leaves shorter or longer. Bracts 3-11, 2.1-30 cm. long; umbels simple, rays 3-12; spikes sessile or peduncled, cylindric in flower. Spikelets erect or sub-erect or spreading at right angles, subulate or cylindric, often curved, not markedly compressed, 1-4-flowered; glumes not aristate; nut-bearing glume cuspidate or not. Spikelets bearing 1-3, rarely 4, nuts. Nuts oblong-ellipsoid, or obovate-oblong or narrowly elliptic-oblong, obtuse or with an acute apex, muricate or not, straight or curved.

A most variable plant, depending much on the habitat and fertility of the soil and on the amount of shade. The number of spikes appears to be conditioned by the growth of the individual, and so also the number of flowers in each spikelet. Spikes are found with and without branches to every degree.

This plant is so variable that to separate the Bombay material is quite a hopeless task both in the herbarium and in the field. Specimens of this plant have been obtained in one and the same locality and at the same time which could be assigned to one or the other of the above species or their varieties as given in C. B. Clarke.

It is significant that nearly all the *Umbellati* were considered by Bentham

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as varieties of his *Cyperus umbellatus*. It would be sounder to treat those 'varieties' as forms.

Locality: Without locality (Dalzell !).—*W. Ghats*: Igatpuri (Blatter & Hallberg 1746 ! 2800 !, McCann 2385 !); Khandala (Blatter, Hallberg & McCann 28580 !, Sedgwick 2553 !); Panchgani (McCann 2758 ! 3010 ! 3011 !, Sedgwick 7926 !), slope of Tableland (Fernandez 1745 !); foot of Tableland (McCann 2759 !); in forest below Third Tableland (McCann 2876 !); Londa, 1,600 ft. (Sedgwick 2739 !).—*Konkan*: (Law ex Cooke); Sativali Forests, Bassein, Thana (Ryan 1088 !); Parol Forest, Bassein Range (Gammie 2441 !); Sion Hill, W. slope, in gravel, under the dripping of the Cracker store house roof (Blatter & McCann 613 ! 2440 !, McCann 937 ! 940 ! 945 ! 946 ! 947 ! 948 !); Vetora (Sabnis 612 ! 33112 ! 33122 ! 33419 !); Mulgaon, Salsette (Blatter & McCann 2440 !).—*S. M. Country*: Devarayi, forests, 1,500 ft. (Sedgwick 4101 ! 4105 ! 4108 ! 4109 !); Tavargatti, sandy ground by forest, 2,000 ft., rainfall 70 in. (Sedgwick 2556 !); Badami (Bhide !); Dharwar, in shade of trees, 2,400 ft., rainfall 34 in. (Sedgwick 6211 !).—*N. Kanara*: (Talbot !, Hallberg & McCann C114 ! C115 !); Devimane Ghat, 600 ft., rainfall 250 in. (Sedgwick 6946 !); Malemani Ghat, 1,000 ft., rainfall 300 in. (Sedgwick 7204 !); Yellapur (Talbot !); Haliyal (Talbot 1884 !); Karwar (Talbot !).

Flowering & fruiting: May 1918 (Vetora); July 1883 (Karwar); July 1917 (Sion, Tavargatti, Khandala, Mulgaon); July 1918 (Devarayi); July 7th, 1925 (Panchgani); July 26th, 1904 (Parol); July 28th, 1930 (Panchgani); July 30th, 1903 (Sativali); August 1887 (Karwar); August 1917 (Londa); August 1919 (Dharwar); August 2nd, 1884 (Haliyal); August 16th and 25th, 1930 (Panchgani); August 25th, 1929 (Sion); August 31st, 1930 (Panchgani); September 1917 (Igatpuri); September 8th, 1911 (Badami); October 1917 (Igatpuri); October 1919 (Malemani, Devimane); October 1921 (Panchgani); October 10th, 1884 (Yellapur).

Field notes: Stems 3-gonous, highly polished, stiff, dark green, inclined at an angle, not upright. Rhizome black, hard. Spikelets pale green, becoming straw-coloured on drying, fragile.

A monsoon species, but the rhizome is perennial, usually growing at the margins of forests or in the shade of trees or rocks. Flowering in July.

The rhizomes are hard and woody. The internodes are very short; the nodes appearing close together give the rhizome an annulated appearance.

Distribution: Throughout India.—Warm regions of the Old World.

4. Mariscus konkanensis Sedgwick in Journ. Bomb. Nat. Hist. Soc. xxv (1918) 698.—*Cyperus konkanensis* T. Cooke in Fl. Bomb. Pres. ii, 874.

Description: Cke. l.c.

Locality: Without locality (Dalzell, H.I.F.I.).—*W. Ghats*: (Woodrow 34 ex Cooke); Khandala (Bhide 15417 !); Purandhar Fort (Blatter & McCann 5572 !, Bhide !); Mahableshwar, grassy bank in forest, S. side of plateau (Sedgwick 4617 !); Fitzgerald Ghat, common (McCann 2974-2978 ! 3410 !).—*Deccan*: Kirkee, Mr. Gammie's compound (Garade 556 ! very likely cultivated); Singhar (Garade 62 !).

Flowering & fruiting: July 21st, 1902 (Kirkee); July 30th, 1902 (Singhar); August 28th, 1930 (Fitzgerald Ghat); September 7th, 1907 (Purandhar); September 20th, 1902 (Khandala); September 24th, 1930 (Fitzgerald Ghat); November 1919 (Mahableshwar); December 1917 (Purandhar).

Field notes: A very characteristic species, and easily recognized by its habit. Growing in dense tufts on the hillside of Mahableshwar. The rhizomes give off bunches of blackish tubers at intervals. Inflorescence pale, almost straw-coloured even in the fresh state. Grows on steep banks at the margin of the forests bordering on the Fitzgerald Ghat Road and also on the cliffs and overhanging rocks where sufficient earth has accumulated. Commences to flower about the middle of August. The old stems of the preceding year are frequently to be seen with the new. During the dry season the plant dries up completely. The spikelets in fresh condition are stiff and spreading. The leaves are paler beneath.

Distribution: W. Ghats, Deccan.—So far endemic.

Though this species has been called '*Konkanensis*' by Cooke, it seems very evident that it does not occur in the Konkan. Cooke described the species from

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a single specimen obtained by Woodrow and probably labelled in a careless way 'Konkan' without any other definite locality. From our own observations this species does not descend far beyond the 5-mile limit down the Fitzgerald Ghat which goes to indicate that it does not go down to the plain or to a low elevation.

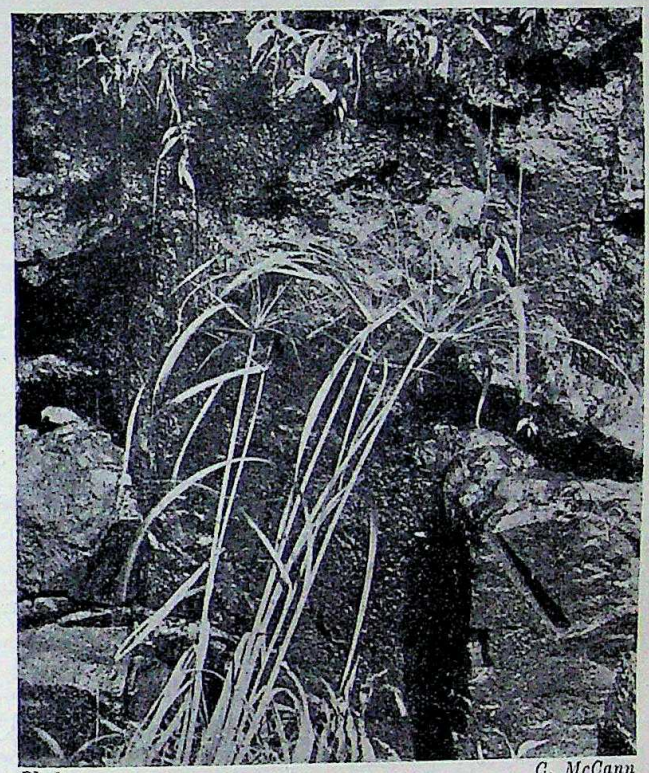

Photo *C. McCann*

Mariscus konkanensis Sedg.

5. **Mariscus pennatus** Domin in Biblioth. Bot. lxxxv (1915) 440.—*Cyperus pennatus* Lam. Ill. i, 144; Cke. ii, 875.—*C. canescens* Vahl Enum. ii, 355 (*excl. syn.* Rheede).—*Mariscus albescens* Gaud. in Freyc. Voy. Bot. 415.

Description: Cke. l.c.

Locality: *W. Ghats*: Lonavla (Woodrow ex Cooke, Herb. E.B.B. !).—*Konkan*: (Cooke, Paranjpye 168 ! several sheets of the same number labelled 'Konkan'); Murdi, near Aiyala, seacoast, just near highwater mark (Paranjpye !); Mahad (Woodrow ex Cooke).

Flowering & fruiting: March 1926 (Konkan); November 16th, 1926 (Murdi).

Distribution: From Bengal to Ceylon and Singapore, tropical Africa, Mascarene Islands, S.-E. Asia, Malaya, Australia, Polynesia.

6. **Mariscus compactus** Druce in Rep. Bot. Exch. Cl. Brit. Isles 1916, 634 (1917).—*M. microcephalus* Presl. Rel. Haenk. i (1830) 182.—*Cyperus compactus* Retz. Obs. v (1789) 10.—*C. spinulosus* Roxb. Fl. Ind. i (1832) 203.—*C. dilutus* Vahl Enum. ii (1806) 357; Cke. ii, 875.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*W. Ghats*: Castle Rock (Gammie 15529 !).—*Konkan*: (Herb. St. X.C. 3127 !); Bombay Reclamation S.-W. of

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Churchgate Station[1] (McCann !); Andheri (McCann !); Jungar Hills, Thana (Paranjpye !); Mahad (Woodrow !); near Malad, in a ditch along railway line (McCann 1341-1344 !).—*S. M. Country*: Devikop, in a pool (Sedgwick 1900 !); marshes near Alnavar, 2,000 ft. (Sedgwick 2916 !).—*N. Kanara*: Siddhapur, 1,600 ft., rainfall 100 in. (Sedgwick 7022 !); Yellapur, bank of a tank (Talbot 1024 !).

Flowering & fruiting: September 1917 (Alnavar); September 29th, 1929 (near Malad); October 1919 (Siddhapur); October 24th, 1902 (Castle Rock); October 30th, 1907 (Thana); November 1916 (Devikop).

Field notes: A tall, tufted, stiff looking plant with long thick arching leaves. The umbels are large with chocolate-brown spikelets, turning reddish on drying and in herbarium material. The leaves have sharp serrulate margins which cut readily.

A plant inhabiting marshes and ditches and other wet places. Purely a monsoon species and one of the latest to come into flower—about the middle of September.

Distribution: Throughout India, 0-3,000 ft.—Mauritius, China, Malaya.

6. Courtoisia Nees (Cke. ii, 877).

Species 2.—Tropical Asia, Africa.

1. **Courtoisia cyperoides** Nees in Linnaea ix (1835) 286; Benth. in Hook. Ic. Pl. (1880) t. 1341; Cke. ii, 877.—*Kyllinga cyperoides* Roxb. Fl. Ind. i (1832) 182.—*Mariscus cyperoides* Dietr. Sp. Pl. ii, 348.

Description: Cke. l.c.

Locality: *Konkan*: (Law ex Cooke).—*S. M. Country*: Hulkop, Dharwar Dist., 2,000 ft., rainfall 40 in. (Sedgwick 3451 !); Havasbhavi, water holes, 1,800 ft., rainfall 33 in. (Sedgwick 1973 !); Dastikop, 2,500 ft., rainfall 35 in. (Sedgwick 2080 !); fairly common in Maval tract (Sedgwick).—*N. Kanara*: Gersoppa Falls, 1,400 ft., rainfall 200 in. (Herb. Sedgwick & Bell 7153 !); Yellapur (Talbot 1563 !).

Flowering & fruiting: October 1919 (Gersoppa); October 10th, 1884 (Yellapur); December 1916 (Dastikop); December 1917 (Hulkop; Havasbhavi).

Distribution: From Sikkim and Assam to Pegu, Konkan, S. M. Country, N. Kanara, Coorg, Mysore, Nilgiris, Malabar, Carnatic.—Madagascar, tropical Africa.

7. Eleocharis R. Brown (Cke. ii, 887).

Species 90.—Cosmopolitan.

Key after Cooke.

A. Glumes subrigid, smooth, striate, concolorous; stems usually stout; stigmas 2-3
  I. Nut smooth; stems terete, transversely septate when dry ... ... 1. *E. plantaginea.*
  II. Nut longitudinally striate; stems subtriquetrous below the spikelet, not septate
    1. Spikelets acute; glumes ovate, subacute . 2. *E. fistulosa.*
    2. Spikelets obtuse; glumes quadrate, rounded or subtruncate ... ... 3. *E. spiralis.*

B. Glumes membranous, usually 1-3-nerved, with a green keel; stems usually slender ...
  I. Stigmas 2, not compressed ... ...
    1. Roots fibrous; rhizome short or 0
      a. Bristles glistening, white ... ... 4. *E. atropurpurea.*
      b. Bristles brown or rusty ... ... 5. *E. capitata.*
    2. Rhizome creeping; bristles rusty-brown ... 6. *E. palustris.*
  II. Stigmas 3
    1. Nut prominently trabeculate ... ... 7. *E. Chactaria.*
    2. Nut smooth ... ... 8. *E. congesta.*

[1] This species has in all probability been introduced from Salsette along with the earth used for filling in.

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1. **Eleocharis plantaginea** R. Br. Prodr. (1810) 224 (*in nota*); Cke. ii, 888.—*Scirpus plantaginus* Roxb. Fl. Ind. i (1832) 212.—*Scirpus plantaginoides* Rottb. Descr. *et* Ic. (1773) 45, t. 15, fig. 2.

Description: Cke. l.c.

Cooke in the clavis distinctly states that the glumes are keeled, but in the description he contradicts this by saying that the glumes are not keeled.

Locality: Bombay, without locality (Herb. Kew ex Cooke).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: Dansura tank, N. Modasa (Sedgwick 1071 !); Prantij (Saxton 2927 !); Baroda (Woodrow ex Cooke, Herb. Col. of Sc. Pa. now in Cal. !).—*Konkan*: Varol Tank, Bhivandi, near Kalyan (McCann 1696 !).—*S. M. Country*: Bomigatti, tank, Dharwar Dist., 2,000 ft., rainfall 35 in. (Sedgwick 3829 !).—*N. Kanara*: Hattikeri, Karwar, in a tank (Herb. Sedgwick & Bell 6768 !, Hallberg & McCann C13 !); Karwar (Sedgwick 6678 !, Hallberg & McCann C14 ! C15 ! C91 !, Talbot !).

Flowering & fruiting: March 1918 (Bomigatti); August 1890 (Karwar); September 1915 (Dhansura); October 1919 (Hattikeri, Karwar); October 26th, 1930 (Bhivandi).

Field notes: 'In a few inches of water on the margin of the Bokh. Gregarious over a few square yards. Not seen elsewhere. Heads light brown.' (Saxton).

At Varol Tank, we found this species occupying large areas both in deep and shallow water. So dense were the groups that the stems were interlaced. Few specimens were in flower at the time (October 26th, 1930) as the water level was still very high. Stem terete, striate, and of a bluish green.

Distribution: N.-W. India, Assam, Sind, Gujarat, Konkan, S. M. Country, N. Kanara, Mysore, Coimbatore, Carnatic, Travancore.—Ceylon, Malay Peninsula, tropics of the Old World.

2. **Eleocharis fistulosa** Link. in Spreng. Jahrb. Gewächs. (1820) Heft 3, 78; Cke. ii, 888.—*Heleocharis fistulosa* Boeck. in Linnaea xxxvi (1870) 472.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 626.

Description: Cke. l.c.

Cooke states that the bristles are longer than the nut, Clarke figures them as such (Ill. of Cyp.), and in Hooker the bristles are said to be shorter than the nut. We find them longer than the nut.

Locality: *W. Ghats*: Panchgani, Tableland (McCann & Fernandez 1729-1734 !); Castle Rock (Bhide !).—*S. M. Country*: Bomigatti, Dharwar Dist., in a tank 1,800 ft., rainfall 35 in. (Sedgwick 3826 !); Badami (Bhide !).—*N. Kanara*: Yellapur (Talbot 1040 !).

Flowering & fruiting: March 1918 (Bomigatti); September 8th, 1911 (Badami); October 1909 (Castle Rock); October 1st, 1884 (Yellapur); November 22nd, 1930 (Panchgani).

Field notes: In Panchgani we observed the plants in a monsoon pool on the Tableland associated with *Scirpus corymbosus*, in August. The stems were tufted, purplish below but otherwise of a dull green colour. The specimens did not flower till after the middle of November. The soil was soft sticky clay.

Distribution: From Nepal and Assam to Burma, W. Ghats, S. M. Country, N. and S. Kanara, Mysore.—Ceylon, Tropics generally.

3. **Eleocharis spiralis** R. Br. Prodr. (1810) 224 (*in nota*); Cke. ii, 888.—*Scirpus spiralis* Rottb. Descr. *et* Ic. (1773) 45, t. 15, fig. 1.

Description: Cke. l.c.

Locality: *Konkan*: Bassein (Blatter & McCann 2358 !); Bombay (Blatter & Hallberg Sedgwick's No. 3473 !); Sion (Blatter & McCann 2731 !); Salsette (Jacquemont 725 ex Cooke).—*Goa* (Lisboa 45 ex Cooke).—*N. Kanara*: Karwar (Talbot !).

Flowering & fruiting: August 1885 (Karwar); September 1917 (Sion); November 1916 (Sion).

Distribution: Bengal, Burma, Konkan, N. Kanara, Goa, Carnatic.—Ceylon, Mauritius, Cochin-China.

4. **Eleocharis atropurpurea** Kunth Enum. ii (1837) 151; Cke. ii, 889.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Ahmedabad, nala near Watraj (Sedgwick 293 !); Godra (Woodrow ex Cooke).—*W. Ghats*: Igatpuri

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(Blatter & Hallberg 3204 ! 5141 !); Khandala (Blatter & McCann 1740 !).—*Konkan*: Parel (Blatter & McCann 3218 !); Sion (Blatter & McCann 3070 ! 1989 !); Kalyan (Woodrow or Cooke H.E.B.B. !).—*N. Kanara*: Karwar, rice fields (Sedgwick 6718 !, Hallberg & McCann C87 !); Kumpta, rice fields (Talbot !).

Flowering & fruiting: January 1917 (Igatpuri); August 1917 (Parel); September 1914 (Wadaj); September 4th, 1895 (Kalyan); October 1919 (Karwar); November 1916 (Sion); December 10th, 1883 (Kumpta).

Distribution: W. Himalaya, Assam, Sind, Rajputana, Gujarat, Konkan, W. Ghats, S. and N. Kanara, Carnatic.—Ceylon, Tropics generally.

5. **Eleocharis capitata** R. Br. Prodr. (1810) 225; Cke. ii, 889.

Description: Cke. l.c.

Locality: *Sind*: (Dalzell ex Cooke); Jamadar ka Landa (Stocks ex Cooke).—*Gujarat*: Godhra (Woodrow).—*Khandesh*: Bor, Tapti River, sandy mud (Blatter & Hallberg 3224 !); Dhulia, Noti tank (Chibber !).—*W. Ghats*: Mahableshwar (Chibber !); Londa (Gammie !).—*Deccan*: Poona (Woodrow ex Cooke, Kelkar !), riverside (Bhide 24 !); Mangri, near Poona (Gammie 15348 !); Nira Canal, Poona Dist. (Chibber !); Chinchwad (Woodrow or Cooke ?, H.E.B.B. !); Trimbak (Chibber 416 !).—*Konkan*: Pen (Blatter, Hallberg & McCann 3228 !); Bandra, sandy shore (Vakil C90 !).—*S. M. Country*: Hubli (Sedgwick 4907 !); Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4480 !); Bagalkot, riverbank (H.E.B.B. !).—*N. Kanara*: (Thomson ex Cooke); Karwar, seashore (Sedgwick 5051 ! 5103 !); mouth of Kala Nuddi River (Hallberg & McCann C89 !); Kumpta, rice fields (Talbot !).

Flowering & fruiting: February 1917 (Pen); March 14th, 1908 (Nira Canal); March 20th, 1908 (Mahableshwar); April 16th, 1906 (Bagalkot); May 1900 (Londa); May 8th, 1902 (Poona); July 1919 (Bandra); August 17th, 1902 (Mangri); September 20th, 1895 (Poona); September 29th, 1895 (Chinchwad); October 1918 (Devarayi); October 1919 (Kala Nuddi); November 1894 (Godhra); November 30th, 1907 (Trimbak); December 1916 (Bor); December 1918 (Hubli, Karwar); December 10th, 1883 (Kumpta); December 27th, 1907 (Dhulia).

Distribution: Bihar, Bengal, throughout the Bombay and Madras Pres., Singapore.—Ceylon, most warm countries.

6. **Eleocharis palustris** R. Br. Prodr. (1810) 224 (*in nota*); Cke. ii, 890.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Clarke); Hyderabad (Woodrow ex Cooke).

Distribution: From the W. Himalaya, ascending to 12,500 ft., to Sind and Bengal.—Cosmopolitan except Australia.

7. **Eleocharis Chaetaria** Roem. & Schult. Syst. ii (1817) 154; Cke. ii, 890.

Description: Cke. l.c.

Locality: *W. Ghats*: Castle Rock (Gammie 15738 !); Londa (Herb. Col. of Sc. Pa. now in Cal. !, Woodrow ex Cooke).—*Konkan*: Vetora, near stream (Sabnis C86 !).—*S. M. Country*: Dharwar (Woodrow ex Cooke).—*N. Kanara*: 30 miles E. of Karwar, rivulet by road (Sedgwick 6570 !); marshes at Supa (Sedgwick 4861 !); Sirsi to Siddhapur (Hallberg & McCann C85 !); Kadra, banks of Kala Nuddi (Talbot 1316 !).

Flowering & fruiting: October 1919 (Sirsi to Siddhapur, E. of Karwar); October 10th, 1889 (Kadra); October 27th, 1902 (Castle Rock); November 1918 (Supa); December 1919 (Vetora).

Distribution: More or less throughout India.—Ceylon, Malacca, Tropics generally.

8. **Eleocharis congesta** Don. Prodr. 41.—*Scirpus congestus* Spreng. Syst. Cur. *post.* 27.—*Eleocharis purpurascens* Boeck. in Linn. xxxvi, 455.

Description: A caespitose sedge 20-30 cm. high with slender nearly terete 8-10-fluted or -striate stems and a terminal many-glumed ovoid or conical spikelet 5-7.5 mm. long, frequently with subsidiary branches from the axil of the bract which may bear a smaller spikelet. Glumes 2 mm. ellipsoid-oblong, concave, not keeled, hyaline in centre and with often coloured margins or a coloured band between the centre and margins, midrib very fine. Stigmas 3, longer than the short style. Nut straw-coloured, 1.25 mm. without or 1.5 mm. with the narrow-conical style-base, obovoid or pyriform, obscurely 3-angled. Bristles rather stout, a little longer than nut, retrorsely scabrous.

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Locality: *S. M. Country*: Devarayi, in rice fields, 1,800 ft., rainfall 90 in. (Sedgwick 4421 !).

Flowering & fruiting: October 1918 (Devarayi).

Distribution: Kashmir, Nepal, Chota Nagpur, S. M. Country, Nilgiris and Pulney Hills, 5,000-7,000 ft.—Ceylon.

8. FIMBRISTYLIS Vahl. (Cke. ii, 878).

Species 225.—Chiefly tropical.

A. *Eleocharoides*. Stem with 1 spikelet. Glumes not distichous (occasionally 1-3 spikelets in *F. polytrichoides;* see also *F. schoenoides*)
- I. Nut narrowly elongate, cylindric, curved ... 1. *F. tetragona.*
- II. Nut obovoid, biconvex, with 6-8 very deep transverse corrugations ... ... 2. *F. acuminata.*
- III. Nut elegantly obovoid with almost obcordate apex, biconvex, minutely subtuberculately dotted ... ... 3. *F. polytrichoides.*

B. *Dichelostylis*. Spikelets more than one. Style bifid. Ovary and fruit compressed, biconvex
- I. Spikelets 1-3, rarely up to 5, large, ovate, pale, glistening ... ... 4. *F. schoenoides.*
- II. Spikelets more than 5 in fully grown individuals
  - 1. Spikelets in a capitate head ... ... 5. *F. argentea.*
  - 2. Spikelets umbelled
    - a. Small tufted annuals
      - † Nut smooth ... ... 6. *F. aestivalis.*
      - †† Nut ribbed and trabeculate ... 7. *F. dichotoma.*
    - b. Taller
      - † Glumes obtuse with hyaline margins and tips. Nut dark, not ribbed or trabeculate ... ... 8. *F. spathacea.*
      - †† Glumes mucronulate, glabrous. Nut pale, ribbed and trabeculate ... 9. *F. annua* var. *diphylla.*
      - ††† Spikelets large, dark red-brown. Glumes usually pubescent in upper half. Nut pale, smooth ... ... 10. *F. ferruginea.*

C. *Trichelostylis*. Spikelets more than one. Style 3-fid. Ovary and fruit trigonous
- I. Spikelets in a capitate head, white ... 11. *F. digitata.*
- II. Spikelets not capitately arranged
  - 1. Small annuals
    - a. Nut white, trabeculate ... ... 12. *F. Woodrowii.*
    - b. Nut white, yellow or grey, tuberculate 13. *F. tenera.*
  - 2. Medium or tall
    - a. Base of stem thick, rhizomatous, leaves short, pungent, crowded, a denizen of grassland ... ... 14. *F. junciformis.*
    - b. Not as a
      - † Stem triquetrous above, glumes obtuse ... ... 15. *F. miliacea.*
      - †† Stem 4-5-angled above, glumes acute ... ... 16. *F. quinquangularis.*
      - ††† Stem flattened above, lowest bract broad, quite erect ... ... 17. *F. complanata.*

D. *Abildgaardia*. Lower glumes of the spikelet distichous or subdistichous. Style 3-fid ... 18. *F. monostachya.*

1. **Fimbristylis tetragona** R. Br. Prodr. (1810) 226; Cke. ii, 879.—*F. cylindrocarpa* Boeck. in Linnaea xxxvii (1871) 7.

Description: Cke. l.c.

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Locality: Without locality (Dalzell in Herb. Kew ex Cooke).—*W. Ghats*: Igatpuri (Blatter & Hallberg 2846 ! 3208 ! 3216 !, McCann 2379 !); Tringalwari, near Igatpuri (Blatter & Hallberg 1968 !); Khandala (Blatter & McCann 3153 ! 5317 !, McCann 344 ! 381 ! 382 !), marshes (Sedgwick 2550 !), in a ditch near the station (McCann 404 !); Lonavla (Chibber !); Londa (Gammie ! & 15839 !).—*Deccan*: Between Nadsur and Pali (Gammie 16046 !); Hirdosi (Woodrow ex Cooke); Mawal (Woodrow ex Cooke).—*Konkan*: (Stocks ex Cooke); Karanja Isl. (Boivin 782 ex Clarke); Salsette (Jacquemont 747 ex Cooke); Lower Parel (Blatter & McCann 4252 !); Kalyan (Herb. St. X.C. 3121 !); Oservira, Mokhada, Thana Dist. (Ryan 189 !); Kankeshwar Hill, Alibag (Bhide !); Mulland, in a marsh (McCann 820 !); foot of hills W. of Mulland, in a puddle (McCann 891 ! 894 !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4461 !); Bidi, Belgaum Dist., 2,500 ft., rainfall 50 in. (Sedgwick 3020 !); Havasbhavi, fields, 2,000 ft., rainfall 33 in. (Sedgwick 1942 !); in a nala near Yelvigi, Dharwar Dist., 2,000 ft., rainfall 30 in. (Sedgwick 1904 !); Badami (Bhide !).—*N. Kanara*: (Law ex Cooke); Karwar (Hallberg & McCann C48 ! C49 !), edges of rice fields (Talbot 1306 !), common in rice fields (Talbot 1507 !); Jog to Siddhapur (Hallberg & McCann 35089 !).

Flowering & fruiting: March 1917, March 1929, April 1929, June 1917 and July 1916 (Khandala); August 11th, 1929 (Mulland, and foot of hills W. of Mulland); August 25th, 1885 (Karwar); September (Kalyan); September 1917 (Igatpuri, Bidi to Belgaum); September 8th, 1911 (Badami); October 1917 (Igatpuri); October 1918 (Devarayi); October 1919 (Karwar, Jog to Siddhapur); October 4th, 1907 (Lonavla); October 6th, 1899 (Londa); October 7th, 1919 (Lonavla); October 10th, 1910 (Alibag, Kankeshwar Hills); October 16th, 1891 (Londa); October 17th, 1902 (Oservira); November 1916 (Yelvigi); November 1st, 1917 (Igatpuri); November 2nd, 1902 (Londa); December 1916 (Havasbhavi); December 9th, 1902 (Nadsur to Pali).

Field notes: Purely a monsoon species which may occasionally be met with in and near marshes throughout the year. The monsoon forms are decidedly larger than those obtained during the dry season. The stems are greenish covered with a whitish or grey powdery substance—tufted, terete. The heads are pale when young in the monsoon form and become brown when mature. Flowering commences in early July in the monsoon forms and after the rains are over the plants die down.

Distribution: Throughout India, except the N.-W.—Ceylon, E. Asia, Australia.

2. **Fimbristylis acuminata** Vahl Enum. ii (1806) 285; C. B. Clarke in Hook. f. F.B.I. vi, 631.—*Scirpus scaber* Roxb. Fl. Ind. i (1832) 220.

Description: Stems 10-30 cm., slender, obscurely quadrangular, leafless, uppermost sheath produced on one side, 0-12 mm. Spikelet one, erect, lanceolate, 12-18 mm. Glumes ovate, scarcely mucronate, pale or chestnut with green keel; lowest 2-3 empty, much shorter than spikelet. Stamens usually 2. Style nearly as long as nut, flattened, slightly villous at top; branches shorter than style. Nut as long as ½-⅔ glume, biconvex, with 4-7 strong transverse ridges.

Locality: Without locality (Dalzell !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4422 !).—*N. Kanara*: Karwar (Hallberg & McCann C55 !), sandy rice fields by the sea (Sedgwick 5101 !); in a marsh, 30 miles E. of Karwar (Sedgwick 6561 !); Yellapur (Talbot !).

Flowering & fruiting: September 1895 (Yellapur); October 1918 (Devarayi); October 1919 (Karwar); December 1918 (Karwar).

Distribution: Throughout India, 0-3,500 ft., from Kumaon and Assam to Ceylon and Malacca, S. M. Country, N. and S. Kanara, Mysore, Travancore.

3. **Fimbristylis polytrichoides** R. Br. Prodr. (1810) 226; Cke. ii, 879.—*F. juncea* Boeck. in Linnaea xxxvii (1871) 4 (*non* Roem. & Schult.).

Locality: *Konkan*: Bombay, seashore (Herb. Sedgwick & Bell 7316 !), seaface near Mahalaxmi Battery (McCann 354 !), Antop Hill (Blatter & McCann 2450 !); Sion (Blatter & McCann 2370 ! 2726 !, Woodrow ex Cooke); in a marsh near the station (McCann 965 !); Bandra, seashore (Vakil C130 !); Kalyan (Woodrow ex Clarke).—*N. Kanara*: Karwar (Hallberg & McCann C50 !

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Fimbristylis dichotoma Vahl in a marsh at Khandala, W. Ghats.

Fimbristylis miliacea Vahl in a puddle near the Vihar Lake, Salsette Island.

Photos by C. McCann.

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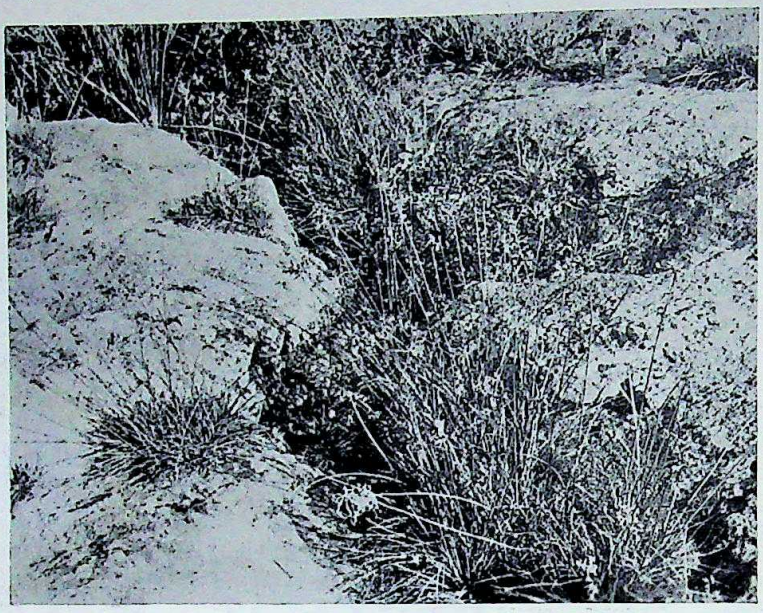
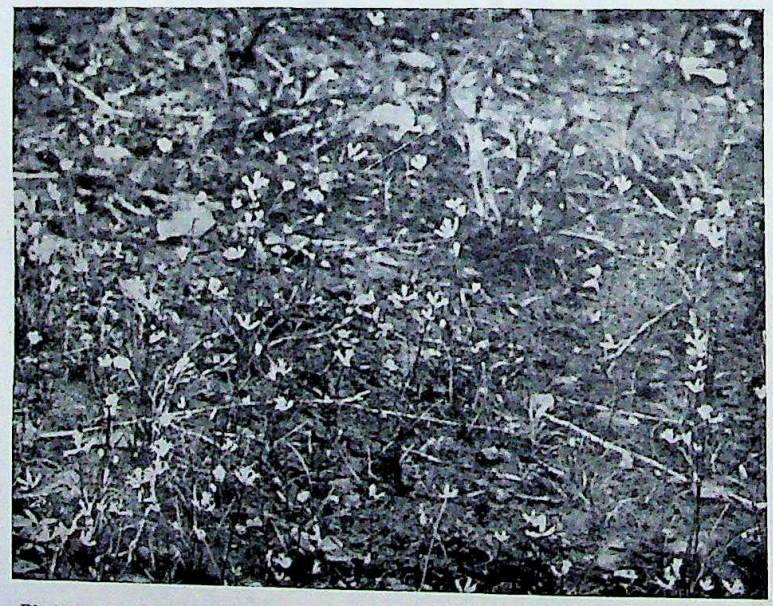


Fimbristylis spathacea Roth. growing on rocks at Mavàl, Rajputana.



Fimbristylis digitata Boeck. on well drained slope at Mulland, Salsette Island.

Photos by C. McCann.

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C52 !), seaface (Sedgwick 6710 !, Talbot !); mouth of the Kala Nuddi River (Hallberg & McCann C51 !).

Flowering & fruiting: March 23rd, 1929 (Bombay); June 1917 (Sion); August 1917 (Antop Hill); August 20th, 1885 (Karwar); August 25th, 1929 (Sion); September 25th, 1892 (near Sion); October 1919 (Karwar); November 1916 (Sion); December 1919 (Bombay).

Field notes: A plant of the seashore and saline marshes, forming densely tufted rosettes, partially prostrate, often radiating from the centre. The general flowering season seems to be the monsoon, but it may be found in flower at any time in the marshes.

Distribution: From Bengal to Ceylon and Malacca, Konkan, N. Kanara, E. coast from Godavari southwards, near the sea.—Tropics of the Old World.

4. **Fimbristylis schoenoides** Vahl Enum. ii (1806) 286; Cke. ii, 880.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 634.

Description: Cke. l.c.

Locality: Without locality (3 sheets H.E.B.B. !).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: Talod, red earth upland (Sedgwick 274 !, Saxton 365 !); Dhansura, Modasa Petha, Ahmedabad Dist., damp ground (Sedgwick !).—*W. Ghats*: Khandala (Woodrow ex Cooke; Blatter, Hallberg & McCann 3036 !; Saxton 1204 !), St. Xavier's Villa (McCann C57 !).—*Konkan*: (Woodrow ex Cooke); Kanari Caves, Salsette (Blatter & McCann 2439 !); Mulgaon, Salsette (Blatter & McCann 2444 !); foot of the hills W. of Mulland, in open ground (McCann 809 !); Vickroli, foot of hills W. of Railway Station, in open ground (McCann 1026 !).—*S. M. Country*: Bidi, Belgaum Dist., in water, 2,500 ft., rainfall 60 in. (Sedgwick 2963 ! 3021 !).—*N. Kanara*: (Hallberg & McCann C54 !); Karwar, hillside (Herb. Sedgwick & Bell 6693 !); Yellapur (Talbot 1507 !).

Flowering & fruiting: July 1916 (Khandala); July 1917 (Mulgaum); August 1914 (Dhansura, Talod); August 1917 (Kanari Caves); August 11th, 1929 (Mulland); August 25th, 1929 (Vickroli); September 1895 (Konkan); September 1917 (Bidi to Belgaum); September 1919 (Khandala); October 1919 (Kanara, Karwar); October 10th, 1884 (Yellapur); October 12th, 1915 (Khandala).

Field notes: Purely a monsoon species, growing in open land. In Salsette we have observed this species forming close carpets intermixed with *Rhyncospora Wightiana* and young grass (*Manisuris* ?). Isolated specimens are also to be met with in open grassland. Flowering commences soon after the break of the rains (about the end of June). A weak-stemmed species with brown polished spikes. When growing in grass it is soon overtopped and apparently disappears. The more or less globose heads and polished glumes readily distinguish it from *F. tetragona* which it closely resembles.

Distribution: Throughout India.—Ceylon, China, Malaya, Australia.

5. **Fimbristylis argentea** Vahl Enum. ii (1806) 294; Cke. ii, 881.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 640.

Description: Cke. l.c.

Locality: Without locality (Dalzell !).—*Gujarat*: Sonasan, by a small bank (Sedgwick 327 !).—*N. Kanara*: Mouth of Kala Nuddi River (Hallberg & McCann C66 !); Karwar (Talbot 1313 !), sandy fields by the sea (Sedgwick 5090 !).

Flowering & fruiting: October 1914 (Sonasan); October 1919 (Kala Nuddi River); December 1918 (Karwar).

Distribution: Bengal, Central India, Gujarat, N. Kanara, Mysore, Cuddapah, Chittor, Nilgiris, Malabar, Travancore, Tinnevelly.—Ceylon, Mauritius.

6. **Fimbristylis aestivalis** Vahl Enum. ii (1806) 288; Cke. ii, 881.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 637.

Description: Cke. l.c.

Fischer (Flora of Madras, p. 1658) has united this species with *F. dichotoma* Vahl. Though these two plants do look alike to a certain extent, they are really two different species and we should like them to remain as such. In the field they very often grow together and are easily picked out. The nut is certainly a good character in the herbarium and once familiar with the plants in the field they are also easily distinguished in the herbarium. *F. aestivalis*

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may also be recognized in the field by its general habit and finer glaucous leaves. It is usually smaller.

Locality: Without locality: (Dalzell !).—*W. Ghats*: Khandala (McCann 1866 ! 1867 ! 3190 !, Blatter & McCann 3175 ! 3177 !, Talbot 4796 !), very common (McCann !), in a marsh near station (McCann 391 ! 392 !); Lonavla (Gammie 16312 ! 16284 !), bed of Lake (Saxton 1497 !); Matheran (Birdwood, Woodrow ex Cooke); Castle Rock, on sand-bank of Duski River (McCann C60 ! Herb. Sedgwick & Bell 5533 !).—*Deccan*: Mawal (Woodrow ex Cooke).—*Konkan*: (Woodrow Herb. !); Bhandup (Blatter & McCann 2411 !); Pen (Blatter, Hallberg & McCann 3215 ! 3250 ! 3248 !); Eastern shore of Vehar Lake, common (McCann 647 !); base of Kanari Caves (McCann 1591 !).—*Goa*: Dudhsagar Falls, Goa frontier (McCann 65 !).—*S. M. Country*: Konankeri, Dharwar Dist. (Sedgwick 4963 !); Devarayi, 1,800 ft. (Sedgwick 4033 !).—*N. Kanara*: (Hallberg & McCann 3124 !, Law ex Cooke); Karwar (Bell 3936 !); Danoli, Amboli Ghat (Gammie 15065 !); Gersoppa Falls (Chibber !); Vincholi (Talbot 943 !); Dandeli (Talbot 2270 !); Palla, south of Mundgod (Herb. Woodrow !).

Flowering & fruiting: January 11th, 1890 (Dandeli); February 1917 (Pen); February 25th, 1929 (Kanari Caves); March 1918 (Khandala); March 1919 (Castle Rock, Dudhsagar); March 31st, 1929 (Khandala); April 4th, 1884 (Vincholi); April 25th, 1906 (Khandala); May 1917 (Khandala); May 1918 (Vetora); May 1st, 1902 (Danoli); May 13th, 1903 (Lonavla); May 17th 1911 (Gersoppa Falls); May 24th, 1916 (Lonavla; bed of lake); June 1918 (Devarayi); July 1917 (Bhandup); July 7th, 1929 (Vehar Lake); December 1918 (Konankeri).

Field notes: On damp sandy places it often forms small rosettes composed mostly of the spikes (inflorescence).—A plant evenly distributed in the Presidency with the exception of the extreme North.

Distribution: More or less throughout India.—S. and E. Asia, Australia.

7. **Fimbristylis dichotoma** Vahl Enum. ii (1806) 287; Cke. ii, 880.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 637.

Description: Cke. l.c.

Locality: Without locality (Dalzell !).—*Sind*: (Stocks ex Cooke); Hyderabad (Chibber !).—*Kathiawar*: Porbandar (Janalekar !).—*Gujarat*: Bodeli (Woodrow !, Blatter 3122 !); Dangs, S. Gujarat (Bell 5440 !); Kabir Vad, Broach (Chibber 772 !, Gammie !); Nadiad (Chibber 251 !); Surat (Gammie 16444 !); Sevalia (Chibber 515 !); Vasvad (Chibber !); in bed of stream under Gorair Bridge, Chitrasani to Sarotra (McCann 1400 !).—*Khandesh*: Bhusawal, N.-E. Tapti River (Blatter & Hallberg 1926 !); Bor, Tapti River, sandy mud (Blatter & Hallberg 3017 !); Nimb, Tapti bank (Blatter & Hallberg 1932 !); Talner, Tapti bank (Blatter & Hallberg 3020 ! 3022 !); Chanseli, N. slope, Taloda (Blatter, Hallberg & McCann 29576 !).—*W. Ghats*: Khandala (Woodrow ex Cooke), in marsh near station (McCann 342 ! 345 ! 385 !), very common (McCann !, Blatter & McCann 3152 !); Lonavla (Gammie 16284 !); Purandhar (Blatter & McCann 5588 !); Panchgani (Blatter & Hallberg B1739 !).—*Deccan*: Sangli, river-bank (Blatter C61 ! C62 ! C63 !); Varavandi, Ahmednagar Dist. (Herb. Sedgwick & Bell 7378 !); Kali (Gammie 15124 !); Poona, riverside (Bhide 2 !); on banks of Nira River (Fernandez C174 ! C186 !).—*Konkan*: (Dalzell-Lambert, Stocks ex Cooke); Pen (Blatter, Hallberg & McCann 3214 !); Mulgaon, Salsette (Blatter & McCann 2445 !); to Karjat (Blatter & Hallberg 3179 !); Vetora (Sabnis 33299 !); Hills W. of Tulsi Lake, in a stream (McCann 355a ! 355b ! 355c !).—*S. M. Country*: Bagalkot, riverbank (H.E.B.B. !); Dharwar Dist., ricefields, very abundant (Sedgwick 2339 !); Sangli, riverbank (Blatter C176 !).—*N. Kanara*: Yellapur (Talbot !); Vincholi (Talbot !).

Flowering & fruiting: January 1917 (Bhusawal, Pen); January 22nd, 1925 (Sangli); February 1919 (Dangs); February 1920 (Varavandi); March 1884 (Yellapur); March 1917 (to Karjat, Khandala, Dharwar Dist.); March 7th, 1929 (Nira River); March 24th, 1929 (Tulsi Lake); March 29th, 1929 (Khandala); April 1884 (Vincholi); April 1917 (Khandala); April 1918 (Karwar); April 5th, 1909 (Hyderabad); April 17th, 1906 (Bagalkot); April 19th, 1909 (Porbandar); May 1914 (bed of Sabarmati); May 1917 (Khandala); May 3rd, 1903 (Lonavla); May 8th, 1902 (Poona); May 16th, 1902 (Karli); July 1917 (Mulgaum); September 1914 (Wadaj); October 24th, 1929 (Chitrasani to Sarotra); October 29th,

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1903 (Surat); November 21st, 1907 (Nadiad); December 1916 (Bor, Nimb); December 1917 (Purandhar); December 1918 (Chanseli); December 3rd, 1907 (Sevalia); December 20th, 1904 (Kabir Vad); December 29th, 1911 (Vasvad).

Field notes: The curious point about this species is that it is mostly concentrated in the drier or Northern parts of the Presidency as is seen from the available material with occasional finds in the Konkan, S. M. Country and Kanara. In the Deccan it is perhaps the commonest plant of the marshes, along river-banks and watercourses throughout the year. It grows in dense rosettes and is extremely prolific. It is very often mixed with *F. aestivalis* which it closely resembles. It grows equally well in soft sticky soil, on sand and among rocks, often attaining a large size when in the two latter situations. Specimens taken in the bed of a watercourse among rocks where sand had collected measured 41.5 cm. whereas the Floras give 25 cm. as the maximum. The specimen referred to was taken in April 1929 and is in McCann's herbarium.

This plant closely resembles *F. aestivalis* as has been mentioned before, but in the field is easily distinguished from it by the colour, as *F. aestivalis* is more inclined to be greyish green. There is a slight difference in the form of the umbel but this is difficult to describe and can be made out only by the practised eye.

'Common on sand and on the Red Soil plateau, Talod. Roots of plants collected by the Khari River are noted as very highly aromatic.' (Saxton & Sedgwick Pl. N. Guj. R.B.S.I. vi, 307).

Distribution: Throughout India, especially in rice fields.—Ceylon, warm regions of the Old World.

8. **Fimbristylis spathacea** Roth Nov. Pl. Sp. (1821) 24; Cke. ii, 882.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 640.

Description: Cke. l.c.

Clarke identified Talbot's Karwar specimen No. 551 as *F. aestivalis* in Herb. Calc. We cannot agree.

The Mirpur Sakro specimen was determined as *F. dichotoma* by B. N. Vakil in the Flora of the Indus Delta.

Locality: *Sind*: (Pinwill ex Cooke); Karachi (Woodrow ex Cooke); Landhi, near Karachi (H.E.B.B. !); Mirpur Sakro (Blatter & McCann D736 !).—*Gujarat*: Loamy and salt encrusted valleys, not uncommon (Saxton and Sedgwick); marshes on the Dhansura, Talod Road (Sedgwick !); nala near Wadaj, marshy ground (Saxton 1822 !); in sandy bed of stream under Gorair Bridge, Chitrasani to Sarotra (McCann 1402 ! 1402a !).—*Konkan*: Uran, Bombay Harbour (Hallberg & McCann 2745 !); Versova, in marsh (Blatter & McCann 29573 !); Bassein (Paranjpye !); Bandra (Wroughton !).—*S. M. Country*: Riverbed, Dharwar Dist. (Sedgwick 2329 !).—*N. Kanara*: Karwar (Talbot 551 !, Hallberg & McCann C69 ! C70 !), sandy seashore (Sedgwick 6674 !); Sulgeri, Kala Nuddi (Bell 4236 !).

Flowering & fruiting: January 1917 (Uran); July 1918 (Versova); July 20th, 1883 (Karwar); August 1914 (Dhansura); August 1918 (Sulgeri); August 9th, 1912 (Bassein); August 16th, 1919 (Wadaj); October 1919 (Karwar); December 1918 (Landhi).

Field notes: A densely tufted species with stiff leaves and stems usually growing on river and tank banks and in crevices of rocks in the same situations.

Distribution: Orissa, Bombay Pres., near the sea on both coasts of the Madras Pres., N. Coimbatore.—Ceylon, Singapore. Warm regions.

9. **Fimbristylis annua** Roem. & Schult. Syst. ii, 95, **var. diphylla** Kükenthal.—*F. diphylla* Vahl Enum. ii (1806) 298; Ckei. ii, 882.—*Scirpus annuus* Allioni Fl. Pedem. ii, 171, t. 88, f. 5.

Description: Cke. l.c.

There is a depauperate specimen in the H.E.B.B. from Bhandala (September 24th, 1895) determined as *F. diphylla* var. *annua* R. & S. We do not think it justifiable to make a variety of such a specimen, as the condition may have something to do with the locality in which the specimen was growing —probably very poor soil. The specimen measures 11.5 cm. whereas the Floras give 15-60 cm.

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C. B. Clarke in F.B.I. vi, 636 has 'Nut 5-13-striated on each face', further on in the description he writes: 'Nut . . . smooth.' We have found the nut of the specimens obtained from Salsette, particularly the larger ones, having the shoulders tuberculate and very obscurely striate.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Talod, red earth upland (Sedgwick 270 !, Saxton 357 !); near Talod (Sedgwick !); Dhansura, Modasa Petha (Sedgwick !).—*W. Ghats*: Igatpuri (Blatter & Hallberg 2811 ! 2817 !); Khandala (Blatter, Hallberg & McCann 3047 ! 3060 !, McCann C80 ! 372 !); Panchgani, Tableland (Blatter & Hallberg B1740 ! B1741 !, McCann 2981 !); Castle Rock, 1,600 ft., rainfall 250 in. (Sedgwick 2740 ! 2824 !); Londa (Gammie 14071 !).—*Deccan*: Ganeshkhind Gardens (Garade !).—*Konkan*: (Stocks, Woodrow ex Cooke); Bassein (Blatter & McCann 2353 !); Vehar Lake, Salsette (Blatter & McCann 2761 !); Vetora (Sabnis 33102 ! 33429 !); Wada Taluka, Thana Dist. (Ryan 693 ! 694 !); Salarwady (Woodrow or Cooke (?) H.E.B.B. !); Sion Hill (McCann 961 !); Mulland, in a marsh W. of village (McCann 812 !); foot of hills W. of Mulland, in open (McCann 890 !); hills W. of Vickroli Station (McCann 1024 !); E. shore of Vehar Lake, by a stream (McCann 638 ! 654 !).—*S. M. Country*: Dharwar, in a water-hole, 2,400 ft., rainfall 35 in. (Sedgwick 6199 !); Devarayi (Sedgwick 4046 !).—*N. Kanara*: Karwar, by a stream (Sedgwick 6603 !, Talbot 601 !, Hallberg & McCann C68 !); Gersoppa Falls, on rocks in riverbed (Hallberg & McCann C84 !).

Flowering & fruiting: March 31st, 1929 (Khandala); May 1918 (Vetora); May 25th, 1900 (Londa); June 1918 (Devarayi); June 13th, 1902 (Ganeshkhind); July 1917 (Khandala); July 7th, 1929 (Vehar Lake); August 1883 (Karwar); August 1914 (Talod, near Talod, Dhansura); August 1917 (Castle Rock); August 1919 (Dharwar); August 11th, 1929 (Mulland); August 25th, 1929 (Sion, Vickroli); September 1902 (Wada Taluka); September 1917 (Igatpuri, Bassein, Devikop); September 1919 (Khandala); September 20th, 1902 (Khandala); September 24th, 1895 (Bhandala); October 1919 (Karwar, Gersoppa Falls); October 1920 (Panchgani); November 1916 (Vehar Lake).

Field notes: Generally speaking this is a monsoon species. A most variable plant growing in the open, and the margins of forests. We have noticed that those specimens which grow in open land mixed with other plants are weak and small, with few spikes, sometimes reduced to one, the nut and glumes being also smaller, compared with those from the margins of forests.

Distribution: Throughout India, up to 6,000 ft.—All warm regions.

9a. **Fimbristylis annua** Roem. & Schult. **var. paucispiculata** Blatter & McCann.—*F. diphylla* var. *annua* C. B. Clarke in Hook. f. F.B.I. vi, 637.

Locality: *W. Ghats*: Khandala (Sedgwick 2588 !), St. Mary's Villa grounds (McCann C82 !).—*Deccan*: Nasik, Lena Hill (Blatter & Hallberg 4537 !).—*Konkan*: Antop Hill, Bombay (Blatter & McCann 2426 !); Trombay (Blatter & McCann 33856 !); Mulgaon, Salsette (Blatter & McCann C59 !).—*S. M. Country*: Devikop, in grass in forest clearing (Sedgwick 2975 !).

Flowering & fruiting: July 1917 (Mulgaon); August 1917 (Antop Hill); September 1917 (Lena Hill, Trombay); September 1919 (Khandala).

Distribution: Bengal, Deccan, Konkan, S. M. Country.

10. **Fimbristylis ferruginea** Vahl Enum. ii (1806) 291; Cke. ii, 881.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 638.

Description: Cke. l.c.

Cooke says: 'Leaves 0 or few', some of the specimens are decidedly leafy at the base. 'Spikelets $\frac{3}{8}$ by $\frac{1}{8}$ in.'—in one specimen obtained in Kanara they measure 18 by 5 mm.

The hairiness of the upper half of the glumes is a good distinguishing character.

Locality: *Sind*: (Pinwill ex Cooke).—*Cutch*: Karu Roa (Blatter 1974 !).—*Gujarat*: Gogha, in tank (Chibber 312 !); road to Lasundra (Chibber 460 !); red earth upland, near Talod (Sedgwick 255 !, Saxton 309 !); in sandy bed of stream under Gorair Bridge, Chitrasani to Sarotra (McCann 1398 !).—*Khandesh*: Bori River (Blatter & Hallberg 2732 !); Amalner, Bori River (Blatter & Hallberg 2758 !).—*W. Ghats*: Khandala station (Blatter & McCann 3001 !); Bhor Ghat (Herb. St. X.C. 3123 !); Panchgani, Dalkeith

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Springs (McCann 3489 !); Pasarni Ghat (McCann 3039 !).—*Deccan*: Gangapur, Nasik (Blatter & Hallberg 2839 ! 4539 !); Poona (Blatter 3125 !, Clarke !, H.E.B.B., Cooke, Woodrow ex Cooke), Ganeshkhind Gardens (Patwardhan !, Garade 434 !); Nira Canal, Poona Dist. (Chibber !); Pashan (Paranjpye !); Mangri, near Poona (Gammie 15345 !); Happy Valley, near Ahmednagar (Paranjpye !); Ahmednagar to Parner Road (Paranjpye !).—*Konkan*: (Talbot 528 ex Clarke); Bombay (Jacquemont 412, ex Clarke), Antop Hill (Blatter & McCann 2423 !); Bandra (Vakil C67 !); Bassein (Chibber !, Blatter & McCann 2354 !); Hills E. of Tulsi Lake, in a stream (McCann 356a ! 356b ! 356c !).—*S. M. Country*: Tegur, Dharwar-Belgaum Road (Sedgwick 5503 !); Dharwar, 2,100 ft., rainfall 34 in. (Herb. Sedgwick & Bell 4989 !); Yelvigi, Dharwar Dist., 1,800 ft., rainfall 30 in. (Sedgwick 2111 !).—*N. Kanara*: Sadashivgad, sands (Bell 7801 !); Karwar, salt marshes (Sedgwick 5100 !); Kala Nuddi at Sulgeri (Bell 4445 !); Kumpta (Chibber !).

Flowering & fruiting: February 1919 (Tegur); March 13th, 1911 (Happy Valley); March 14th, 1908 (Nira Canal); March 24th, 1929 (hills E. of Tulsi Lake); June 13th, 1902 (Ganeshkhind); August 1914 (Talod); August 1917 (Antop Hill, Bandra, Khandala); August 9th, 1905 (Ganeshkhind); September 1917 (Gangapur, Bassein); September 1918 (Kala Nuddi); September 13th, 1907 (Happy Valley); September 21st, 1907 (Ahmednagar to Parner); September 26th, 1895 (Poona); October 23rd, 1914 (Pashan); October 24th, 1929 (Chitrasani to Saroira); November 1st, 1910 (Kumpta); November 29th, 1907 (Gogha); December 1907 (Karu Roa); December 1916 (Yelvigi, Bori River); December 1918 (Dharwar, Karwar, Dadgaon); December 1920 (Sadashivgad); December 2nd, 1907 (Road to Lasundra).

Field notes: In our experience a plant inhabiting the banks of rivers, streams and tanks—sandy soil being preferred. Under these conditions it flowers throughout the year when there is sufficient water.

Distribution: Throughout India.—Ceylon, China, Japan, Malaya, Australia, Polynesia.

11. **Fimbristylis digitata** Boeck. in Flora lxi (1878) 35; Cke. ii, 884.

Description: Cke. l.c.

Locality: *W. Ghats*: Khandala (Blatter, Hallberg & McCann 3052 !, Sedgwick 2595 !, Blatter 1858 !, McCann 1857 ! 3194 ! 3220 !); Lonavla (Garade !, Woodrow ex Cooke).—*Konkan*: (Dalzell, Stocks and Law ex Cooke); Khanoli (Herb. St. X.C. 33561 !); Bhandup to Vehar Lake, very common on open gravelly ground (McCann 648 !); hillsides near Ghatkopar (Sedgwick 1028 !); hills W. of Mulland (McCann 1650 !).—*S. M. Country*: Badami (Woodrow 56 ex Cooke).—*Goa*: Marmagao (Talbot 2506, ex Cooke).—*N. Kanara*: (Law ex Cooke); Belekerry (Talbot 491 ! 1182 !).

Flowering & fruiting: May 1917 (Khandala); May 1918 (Khanoli); June 1892 (Lonavla); June 7th, 1916 (Lonavla); June 10th, 1883 (Belekerry); June 15th, 1885 (Belekerry); June 24th, 1903 (Lonavla); July 1915 (Ghatkopar); July 1916 (Khandala); July 7th, 1929 (Bhandup to Vehar Lake); July 8th, 1902 (Lonavla); August 1908 (Khandala); August 17th, 1889 (Belekerry).

Field notes: An extremely common species growing in open ground on gently sloping hillsides and plateaux on well drained soil usually consisting of gravel or pebbles. Frequently occupying large areas 'apparently' to the exclusion of other plants. This is due to the fact that this species appears soon after the break of the monsoon when the grass with which it is mixed grows slower. As soon as the plants have fruited they 'disappear' as they are usually lost in the longer grasses. They commence to flower soon after the beginning of the rains and disappear as fast.

This species is very conspicuous with its white spikelets arranged in a head at the summit of the usually short filamentous stem and is easily recognized by this character both in the field and in the herbarium from any of the other *Cyperaceae* in the Presidency.

The plants have a thick black tuberous rhizome which persists—hence it should be classed as a perennial. The period of activity of a single plant is barely 2 months.

Distribution: Deccan, Konkan, N. Kanara.—Endemic.

12. **Fimbristylis Woodrowii** C. B. Clarke in Journ. Linn. Soc. xxxiv (1898) 68; Cke. ii, 884.

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Description: Cke. l.c.

Locality: *W. Ghats*: Igatpuri (Blatter & Hallberg 2809 !); Khandala (Woodrow ex Cooke, Sedgwick 2576 !, McCann 3185 !, Blatter, Hallberg & McCann 3002 !, H.E.B.B. !, Woodrow (?) H.E.B.B. !); Castle Rock (Sedgwick 2732 ! 2733 !, Bell 4320 ! 4355 !).—*Konkan*: Malvan (Woodrow ex Cooke).—*N. Kanara*: Karwar (Hallberg & McCann C75 !, Talbot 999 !); roadside E. of Karwar (Sedgwick 6567 !).

Flowering & fruiting: March 1917 (Khandala); May 1917 (Khandala); July 1917 (Khandala); August 1883 (Karwar); August 1916 (Khandala); August 1917 (Castle Rock); September 1917 (Igatpuri); September 1918 (Castle Rock); September 1919 (Khandala); September 24th, 1895 (Khandala); October 1918 (Karwar; E. of Karwar); October 1919 (Karwar).

Distribution: W. India.

13. **Fimbristylis tenera** Roem. & Schult. Syst. ii, Mant. 57.—*F. monticola* Hochst. ex Steud. Syn. Pl. Cyp. (1855) 111; Cke. ii, 885.

Description: Annual, glabrous, except the glumes. Stem slender, 20 cm. long. Leaves half the length of the stem, 1.25-2 mm. broad. Umbel loose, subcompound, of 7-10 solitary spikelets; bracts 2-3, setaceous, shorter than the umbel. Spikelets ellipsoid-lanceolate, nearly 6 mm. long, 2 mm. broad, 10-flowered. Glumes ovate, acuminate, submucronate, boat-shaped, adpressed, glandular-puberulous, chestnut-red, keel yellow, margins conspicuously scarious. Style 3-fid, longer than the nut, deciduous together with its pyramidal base, glabrous. Nut hardly half the length of the glume, obovoid, round-trigonous, white or pallid, coarsely reticulate, smooth or sometimes subtubercled.

Locality: Without locality (Dalzell !).—*Gujarat*: Ahmedabad, nala near Wadaj (Sedgwick 292 !); red earth upland near Talod (Sedgwick 241 !).—*Khandesh*: Talner, Tapti River (Blatter & Hallberg 1859 !); Bor, Tapti bank (Blatter & Hallberg 3013 ! 3023 ! 4453 !); Nimb, Tapti River (Blatter & Hallberg 1930 !).—*W. Ghats*: Khandala (Blatter, Hallberg & McCann 3042 ! 3051 ! 3055 ! 3063 ! 3065 !); Lingmala, on rocks (McCann 3411 ! 3416 !); Panchgani, slope of Tableland (McCann 2806 !).—*Deccan*: Shelarvadi, Bhor Ghat (Woodrow 10 ex Cooke).—*Konkan*: Antop Hill, Bombay (Blatter & McCann 2425 !); Pen (Blatter, Hallberg & McCann 3213 ! 3237 !); Nanjri, Narsery Forest (Ryan 1177 ! 1178 !).—*S. M. Country*: Badami Hills (Paranjpye !).

Flowering & fruiting: January 1917 (Pen); March 1917 (Khandala); July 1916 (Khandala); August 1914 (near Talod); August 1917 (Antop Hill); August 8th, 1906 (Manjri, Nursery Forest); August 18th, 1930 (Panchgani); September 1914 (Wadaj); September 1919 (Khandala); September 1st, 1912 (Badami Hills); September 24th, 1930 (Lingmala); December 1916 (Talner, Bor, Nimb).

Distribution: Throughout Bombay Pres., S. Kanara, Mysore, Bellary, Chingleput, Nilgiris, Anamalais, Travancore.—Ceylon, tropical Africa.

14. **Fimbristylis junciformis** Kunth Enum. ii (1837) 239; Cke. ii, 886.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 647.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Talod, dry place on red earth upland (Sedgwick 282 !, Saxton 376 !).—*Deccan*: Karli (Woodrow ex Cooke).—*Konkan*: Mulgaon, Salsette (Blatter & McCann 2408 ! 2446 !); Bandra (Wroughton !).—*S. M. Country*: Devikop, openings in deciduous forest, Dharwar Dist., 1,800 ft., rainfall 40 in. (Sedgwick 3983 !); Dharwar, 2,400 ft., rainfall 34 in. (Sedgwick 2545 !, Talbot !).—*N. Kanara*: (H.E.B.B. !).

Flowering & fruiting: May 1918 (Devikop); June 1883 (N. Kanara); June 1917 (Dharwar); July 1917 (Mulgaon); August 1893 (Dharwar); August 1897 (Bandra); August 1914 (Talod); August 10th, 1890 (Dharwar).

Distribution: Throughout India.—Ceylon, Madagascar, Philippines.

15. **Fimbristylis miliacea** Vahl Enum. ii (1806) 287; Cke. ii, 883.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 644.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Clarke).—*Gujarat*: Baroda (Blatter 3120 !, Herb. Woodrow !); Grassy path between rice fields, 4 miles N.-W. of Ahmedabad (Sedgwick 312 !).—*W. Ghats*: Khandala (Blatter, Hallberg & McCann

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3050 ! 3059 !, McCann 3193 !, Sedgwick 2575 !), in a marsh (McCann 352 !). —*Konkan*: (Lambert ex Cooke); Bhandup (Blatter & McCann 2417 ! C73 !); Trombay (Blatter & McCann 33857 !); Vetora (Sabnis 33596 !); Tungar Hills, Thana (Paranjpye !); E. shore of Vehar Lake, in a stream (McCann 651 ! 652 !); Borivli to Kanari Caves, margin of a tank (McCann 1110 !), in rice fields (McCann 1162 !); Kalyan (Woodrow ex Cooke).—*S. M. Country*: Devarayi (Herb. St. X.C. C74 !); Havasbhavi, 1,800 ft., rainfall 35 in. (Sedgwick 1986 !); Dastikop, high rice fields, 2,500 ft., rainfall 35 in. (Sedgwick 1859 !).—*N. Kanara*: Karwar (Talbot 1304 !), sandy fields by the sea (Sedgwick 5097 !); Yellapur (Talbot !).

Flowering & fruiting: January 1919 (Bhandup); March 1919 (Dudhsagar Falls); March 31st, 1929 (Khandala); May 1917 (Khandala); May 1918 (Vetora); June 1917 (Bhandup); July 1916 (Khandala); July 7th, 1929 (Vehar Lake); September 1917 (Trombay); September 4th, 1896 (Kalyan); September 10th, 1895 (Karwar); September 15th, 1929 (Borivli to Kanari Caves); October 1902 (Castle Rock); October 1914 (4 miles N.-W. of Ahmedabad); October 5th, 1884 (Yellapur); October 30th, 1907 (Thana); November 1910 (Kanara Dist.); November 1916 (Dastikop); December 1916 (Havasbhavi); December 1918 (Karwar).

Field notes: Almost entirely a monsoon species, but may be found near or in water at any time of the year. The small spikelets and the characteristically flattened basal portion of the stem are good field characters which easily distinguish this species. Habit tufted—gregarious.

Distribution: Throughout India, up to 6,000 ft.—All warm regions.

16. **Fimbristylis quinquangularis** Kunth Enum. ii (1837) 229; Cke. ii, 883. —Synonyms in C. B. Clarke in Hook. f. F.B.I. vi, 644.

Description: Cke. l.c.

Locality: Without locality (Dalzell !).—*Sind*: Chunar, Indus River (Blatter & McCann C183 !).—*Gujarat*: Modasa Petha, marshy banks of Watrak River (Sedgwick 1059 !); Ahmedabad, rice fields (Sedgwick 311 !); Kharagoda (Saxton !); Baroda (Woodrow ex Cooke).—*W. Ghats*: Igatpuri (Blatter & Hallberg 2843 !, McCann 2387 !); Khandala (Blatter & McCann 3170 !, Sedgwick 2573 !), in a marsh near the station (McCann 388 !); Lonavla (H.E.B.B. !); near Shivapur village (Fernandez C175 !); Castle Rock (Gammie !).—*Konkan*: (Law ex Cooke); Bombay (Boivin 987 ex Clarke); Mahim (Blatter & McCann 2729 !); Bassein (Blatter & McCann 2357 !); Andheri (Blatter & McCann 3085 !); Bhandup, near tank (Blatter & McCann 2744 !); Versova (Ryan 1369 !); Mulland, in a marsh W. of village (McCann 821 !); Borivli to Kanari Caves, in open ground near a puddle (McCann 1126 !); along railway line near Malad (McCann 1350 !); Kalyan (H.E.B.B. !). —*S. M. Country*: Devarayi, 1,800 ft., rainfall 30 in. (Sedgwick 4097 ! 4464 !); Alnavar, 2,000 ft., rainfall 40 in. (Sedgwick 2923 !).—*N. Kanara*: Sampkhand (Hallberg & McCann C71 ! C72 !); roadside E. of Karwar (Sedgwick 6568 !); 30 miles E. of Karwar (Sedgwick 6569 !); Yellapur (Talbot 986 !).

Flowering & fruiting: March 1917 (Khandala); March 29th, 1929 (Khandala); July 1917 (Khandala); July 1918 (Devarayi); August 11th, 1929 (Mulland); August 22nd, 1929 (near Shivapur); September 1884 (Yellapur); September 1915 (Watrak); September 1917 (Igatpuri, Bassein, Alnavar); September 15th, 1903 (Versova); September 15th, 1929 (Borivli to Kanari Caves); September 29th, 1929 (Malad); October 1914 (Ahmedabad); October 1917 (Igatpuri); October 1918 (E. of Karwar, Devarayi); October 1919 (Sampkhand, 30 miles E. of Karwar); October 11th, 1914 (Kharagoda); November 1916 (Mahim, Bhandup); December 1916 (Andheri).

Distribution: More or less throughout India.—Ceylon, Malay Peninsula, Malaya, China, Australia.

17. **Fimbristylis complanata** Link Hort. Berol. i (1827) 292; Cke. ii, 886. —For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 646.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Watrak River banks, Modasa Petha (Sedgwick 1060 !); Talod, damp ground on red earth upland (Sedgwick 253 !).—*Khandesh*: Dhulia (Chibber !).—*Deccan*: Gangapur, Nasik (Blatter & Hallberg 2838 !); near Chattersinghi (Ranade ex Cooke); Poona

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(H.E.B.B. !, Clarke !).—*W. Ghats*: Lonavla (Blatter, Hallberg & McCann 2492 !).—*S. M. Country*: Shiggaon, Dharwar Dist., in a cocoanut garden, 2,000 ft., rainfall 30 in. (Sedgwick 3661); Yelvigi, Dharwar Dist. (Sedgwick 4282 !).

Flowering & fruiting: February 1918 (Shiggaon); August 1914 (Talod); August 1918 (Yelvigi); September 1896 (Poona); September 1915 (Watrak); September 1917 (Gangapur, Lonavla); December 28th, 1907 (Dhulia).

Distribution: Throughout India in the warm region.—All warm regions.

Var. microcarpa C. B. Clarke in Hook. f. F.B.I. vi, 446.

Locality: *Deccan*: Poona (Woodrow ex Cooke); water-hole at Hewra (Dalzell ex Cooke).

Distribution: Kumaon, up to 8,000 ft., Sikkim, Bombay.—E. Asia, Australia.

18. **Fimbristylis monostachya** Hassk. Pl. Jav. Rar. (1848) 61; Cke. ii, 885.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 649.

Description: Cke. l.c.

Locality: Without locality (Dalzell !).—*Sind*: (Pinwill ex Clarke).—*Gujarat*: Dhansura, Modasa Petha, damp ground (Sedgwick 249 !).—*Deccan*: Gangapur, Nasik (Blatter & Hallberg 2804 !); Poona (Jacquemont 411 ex Cooke, Herb. St. X.C. 3118 !, Herb. Woodrow !).—*Konkan*: Bandra (Wroughton !); on open plain between the hills W. of Vickroli (McCann 1020 !); foot of hills W. of Mulland (McCann 807 !).—*S. M. Country*: Dharwar, 2,400 ft., rainfall 34 in. (Sedgwick 2688 !), dry hills (Sedgwick 2950 !), stony ground (Talbot 2502 !); Badami (Woodrow ex Cooke).—*N. Kanara*: Karwar (Hallberg & McCann C58 !); Yellapur (Talbot !).

Flowering & fruiting: June 27th, 1893 (Badami); July 1897 (Bandra); July 1917 (Dharwar); July 10th, 1891 (Dharwar); August 1914 (Dhansura); August 11th, 1929 (Mulland); August 25th, 1929 (Vickroli); rainy season (Yellapur); September 1917 (Gangapur, Poona); September 12th, 1895 (Poona); October 1917 (Karwar).

Field notes: Purely a monsoon species. Usually growing in open ground. Forming dense rosettes. Spikes pale green, slightly polished. Isolated specimens filamentous.

Distribution: Throughout warmer India.—All warm regions.

(To be continued).

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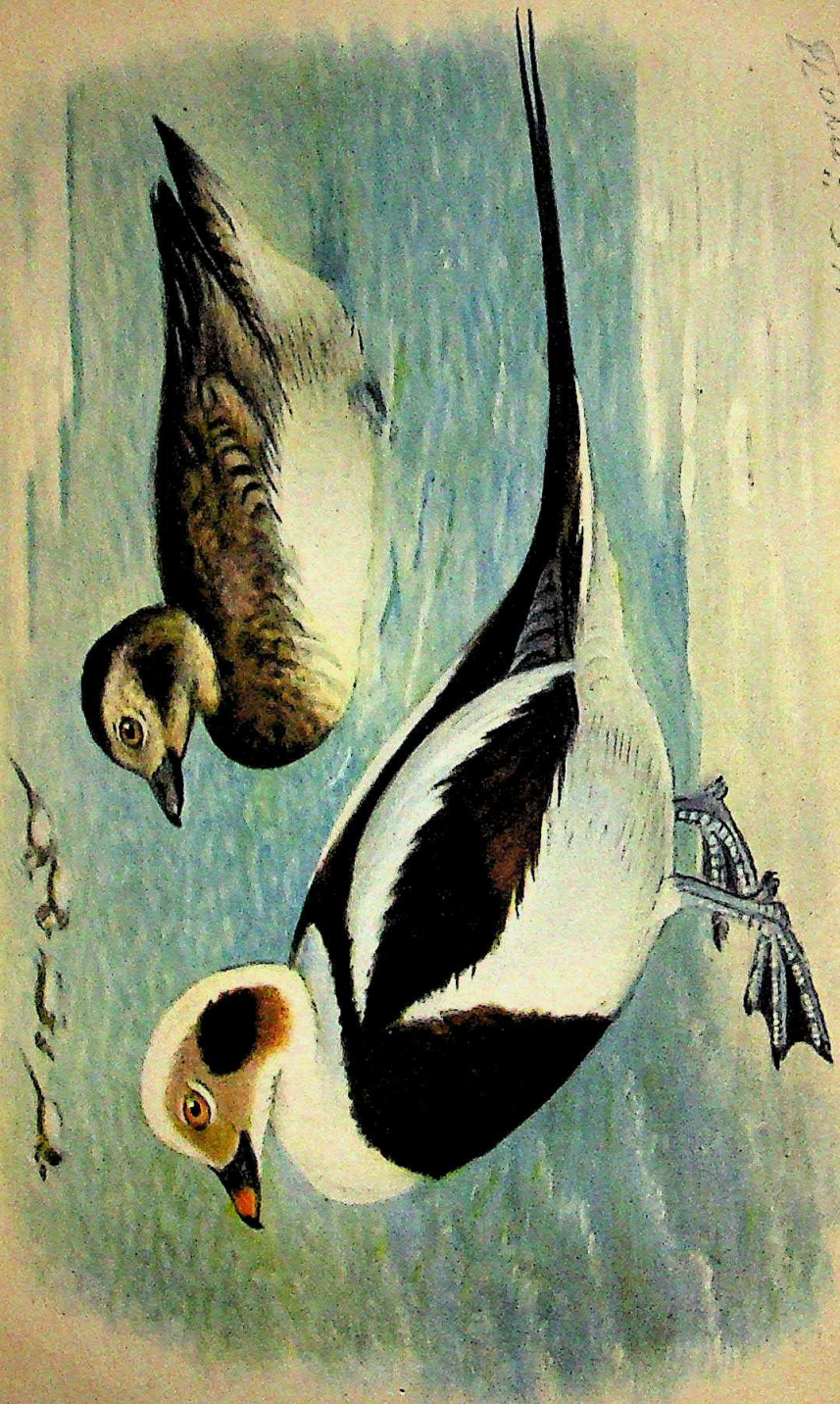

THE LONG-TAILED DUCK
Clangula hyemalis.
⅓

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THE LONG-TAILED DUCK.

BY

E. C. STUART BAKER, C.I.E., F.Z.S., F.L.S.,

M.B.O.U., H.F.A.O.U.

(*With a coloured plate*).

CLANGULA HYEMALIS.

The Long-tailed Duck.

Anas hyemalis Linn. Syst. Nat., 10th ed., vol. i, p. 126, 1758, N. Europe and America. (Restricted to Sweden.)

Description.—Adult male, Winter. A white ring round the eye; posterior ear-coverts, extending to the neck in a broad band, chocolate brown, tinged with chestnut-buff next the neck; chin, throat and foreneck joined to a broad ring round the hind neck and extreme upper back pure white; sides of face and crown grey with narrow white ring next the bill and merging into the white hind neck on the crown; back, rump, upper tail-coverts and central two pairs of tail-feathers chocolate brown; outermost tail-feathers white, the next two pairs with a little brown near the centre of the tip; intermediate pairs grading between the central and outermost; long attenuated scapulars and line of innermost tertiaries pure white; lesser, median and greater coverts nearly black, slightly glossed with green; primaries brown, the shafts of the outer ones white at the base; secondaries dark and chestnut-brown on the outer webs; pale dull brown on the inner; inner secondaries blackish; whole breast and upper abdomen chocolate; abdomen, under tail-coverts and flanks pure white; axillaries and under wing-coverts dull brown; under aspect of wing-quills pale brown.

Colours of soft parts.—Iris golden orange; tip and base of bill as far forward as the anterior edge of the nostril black; intermediate portion orange red; legs, toes and a line on the web on either side of the middle toes bluish white, remainder of the webs black.

Measurements.—Wing 219 to 236 mm.; tail 199 to 246 mm.; tarsus 32 to 35 mm.; bill from feathers of forehead 26 to 29 mm. (Witherby).

Male in summer.—Centre of fore-crown and across whole hind crown, chin, throat, cheeks and nearly entire neck black, well marked with white on hind neck and to a lesser extent on foreneck; breast more black and less chocolate than in winter; scapulars and outer feathers of mantle black with chestnut-buff edges.

Colours of soft parts.—Bill black, legs and feet dull blue-grey.

Male eclipse.—Mantle darker, the black more pronounced; the sides of the body and flanks have drab or grey feathers mingled with the white.

Adult female, winter.—Forehead generally white; lores and face hair-brown; chin dusky changing to white on throat and again to

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dusky on lower fore-neck; remainder of head dark brown; blackish on fore-crown; upper plumage and wings brown, darker and blackish on the mantle, each feather edged with fulvous or greyish, conspicuous when fresh, but soon becoming worn and abraded; extreme upper breast and lower fore-neck brown, more or less mottled with whitish; remainder of lower parts white, axillaries and under-wing-coverts hair brown.

Colours of soft parts.—Iris yellow, yellow-brown or golden; bill greyish-black, sometimes tinged yellowish in the centre; legs and feet greenish-grey, the webs darker and with the same lines next the centre-toe as in the male.

Female, summer.—Upper parts darker and duller than in winter, the edgings to the feathers less bright and conspicuous.

Young in down.—Whole upper parts blackish, at first with rufous tips which soon become abraded; a band across the fore-neck rufescent brown; remainder of lower parts white, the posterior abdomen, vent and flanks with brown bases showing through as a dark mottling.

The bill and feet are black, the iris dark brown.

Distribution.—This very pretty little duck breeds in the far north of Asia, Europe and America. It nests freely in Iceland, the Faroes, northern Europe and Spitzbergen, being very common in northern Lapland and Russia and probably throughout northern Siberia. It also breeds in Arctic North America. In winter it migrates south to the Mediterranean, Black and Caspian Seas and the great inland lakes of Central Asia. In America it occurs at this season as far south as the northern United States and has been recorded from the Gulf of Mexico.

It has only occurred once in India, a male changing from eclipse into winter plumage having been shot by Captain A. E. L. Dredge at Chaman in British Baluchistan on 18th October of 1933.

Nidification.—Breeding so far north as this bird does it is naturally a late breeder and in northern Lapland we found that in hot years it began to breed the first week in June but in the bitter cold year of 1931 no birds had begun to lay on the 23rd June.

We found it breeding on islands, on the coast a little above high water mark, among boulders and stunted vegetation and also on the open tundra by lakes and pools and in a few instances some distance from water. One nest we found was in the centre of some juniper, about 18 in. high and at least a 100 yards from the nearest pool, a second was on a hummock standing in deep swamp, a third under a boulder among some coarse sedge, while a fourth was a hollow in the deep reindeer moss in among some stunted *Salix*. These were very typical examples of the sites chosen for the many others we found or had shewn to us. All the nests found were well hidden and invariably protected by vegetable growth of some kind or by a boulder or rock. The one we found on a hummock, referred to above, was deep in among the roots of *Salix* growing on the top of the mound and entangled with grass and weeds, so that the nest was invisible until this tangle was pulled on one side. The ducks sat very close and most of our

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nests were found when they rose from them within a very few yards of us; some birds got up when we were ten or fifteen yards away but others never stirred until we almost touched them, one duck sitting quite still staring at us until we actually began to move the sedge from the sides of the nest. Another duck whose nest was under some *Tamarisk* on the open tundra, instead of flying off her nest as we approached walked quitely off when we were a few yards away and stood watching us as we examined the eggs and then as quietly walked on again and nestled down on them as we stood close by her. Most ducks, when disturbed, either flew straight away or circled round once or twice and then flew off. In the latter case the duck was joined sometimes by her mate before finally disappearing. Except on such occasions we saw but little of the male near the nest unless they were on small islands when they could generally be seen on the water close by, often swimming about in company with one or two more males. When disturbed from their nests the ducks sometimes uttered a very deep short croak which is so unlike that made by any other duck that it would have sufficed to identify them, even when not seen.

The down in the nests of these ducks is very plentiful, even before incubation has advanced. Most ducks pluck but little down until incubation begins in earnest and the full supply is not placed in position until the young are about to hatch. These ducks, however, start plucking the down and lining and edging the nest with it after the first egg is laid and twice we found nests containing six fresh eggs which were fully lined and banked all round with a fine mass of down. The down is rather small, almost black and with a small pale sooty-brown centre.

The clutches of eggs are small and we found six or seven to be the usual complement while 9 was the greatest number we saw and this only once. Witherby, however, says that ten are sometimes laid. In colour the eggs are very similar to those of the Golden-Eye—an olive or greyish green, sometimes quite bright in tint. In shape, however, they differ greatly; instead of being very broad ovals they are rather long ovals, almost elliptical in shape, the small end hardly differing from the larger.

Jourdain gives the average of 130 eggs as 53.3 × 38.0 mm. maxima *59.5* × 40.0 and 57.5 × *40.5* mm.; minima *47.2* × 35.0 and 48.3 × *34.8* mm.

The average of 48 eggs measured by myself is 52.0 × 37.6 m. The male takes no part in incubation and, so far as we could see, little interest in nest, eggs or young. Even when we were working in the midnight hours we never found the drake near the nest.

Habits.—This is a sea-duck and when in flocks is often found very far from land, riding buoyantly on the roughest sea. Witherby whose experience of the bird has been vastly greater than my own, says that he has often watched it swimming about with its tail held horizontally or even 'draggling in water, when quite undisturbed'. The vast majority, however, of the birds seen by myself, more especially the drakes, held their tails rather high

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out of the water; many certainly held them more or less horizontally but not had them immersed. They are fine divers but do not stay as long under water as the Pochards. Three drakes which gave us a fine diving display off the island of Lunasaari stayed under water for periods of 20 to 40 seconds, the longest I timed being 48 seconds. I have never timed the females but they stay under at least as long and I think sometimes longer. Their flight is very much like that of the Pintails but not so fast though, as I have never seen them flighting or when shot at, it is hard to say that this is always so. Their voice is unlike that of any other duck known to me, a very deep guttural croak carrying to a great distance and never to be confounded with the equally deep notes of the Eider Duck, with which it is so often associated. During the breeding season it is a tame bird. The ducks, as shown above, let you walk right up to the nests before quitting while the males let you watch them fairly closely as they swim about in sea or lake. Like some other ducks, the males during the breeding season often consort in small parties of three to half a dozen. Most of these little 'club parties' wander out far to sea but some remain quite close to land, paddling and diving about just off the coast. We also saw them, though rarely, swimming in lakes and pools, generally singly.

I know nothing about what they eat but Witherby says '*Food* —mainly animal, especially mollusca; also crustacea (shrimps, small crabs, sandhoppers, etc.), *Pteropoda* and occasionally grain from wrecks. In summer fresh-water insects and their larvae including diptera (*Chirononidae* etc.), hemiptera (*corinca*). Small red worms also recorded.'

Whether or not they are good to eat themselves I cannot say as I have never eaten one but the Fins say that they are particularly tender and well flavoured.

A most interesting question in regard to the duck is its acquisition of a very largely white winter plumage. It leaves its summer quarters before the snow commences to fall although it has generally begun to acquire its white feathers. It arrives in its summer home while there is still much snow about but generally in full summer garb. The white plumage seems to have little or nothing to do with winter snows and is not paralleled with the white winter pelage and plumage of ermines, hares, ptarmigan etc. Does it mean that migration with this species is a recently acquired action, if not why the white plumage when this is of no use to it in its winter habitat, but rather the reverse.

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INDIAN DRAGONFLIES.

BY

F. C. FRASER, LT.-COL., I.M.S., F.R.E.S.

PART XLII.

(*With two plates and three text-figures*).

(*Continued from page* 617 *of volume* xxxvi).

Preface.

The publication of a volume of the 'Fauna of British India' series, dealing with the superfamily *Coenagrioidea* has rendered the continuation of the present papers superfluous, as all species not hitherto dealt with in 'Indian Dragonflies', have been dealt with fully in the volume mentioned above.

Under these circumstances, an opportunity is now given to revise some of the earlier parts of 'Indian Dragonflies', the publication of which gave such a tremendous impetus to the study of Indian *Odonata*.

The monograph was started in the year 1918 at a time when both literature and material were hard to obtain and when the author himself was still on field service at the War. It is partly owing to this and partly owing to the enormous strides made since in the study of the Order that a revision of the earlier parts, dealing with the *Anisoptera*, has become so urgent a matter.

The present paper deals with the genus *Idionyx*, and serves to illustrate how great is the need for revision. Only seven species of this genus were known to science in the year 1921 when Part X of *Indian Dragonflies* was published in this *Journal*, but we now know of twenty. Of the seven species, only four were known to occur within Indian limits, but we can now list fourteen. One species has become obsolete as it has been found to be the opposite sex of an already described species, whilst, on the other hand, the male sex of another species has been found to be nonconspecific and is entirely new. Yet another species thought to belong to genus *Phyllomacromia* and afterwards transferred to genus *Idionyx*, is, in this paper, raised to generic rank under the name of *Idiophya*.

In 1921 we knew absolutely nothing about the ecology of the genus but since then, much of the life-history and habits of various species has been learnt first-hand. Nothing further need be said to stress the argument for revision.

I would like to take this opportunity to thank all those who have contributed to the compilation of the monograph, either by the gift of material or advice from specialists in the Order. More especially are my thanks due to Mr. T. Bainbrigge Fletcher, Imperial Entomologist, who was the first to come forward with offers of material, and who continued to supply me with a mass of species for over a decade. To Mr. Chas. Inglis I am also indebted for material from Darjeeling District and Sikkim, and to Col. F. Wall for large collections from Burma and Ceylon. Major Frere collected for me in the Palni Hills and Mr. H. V. O'Donel opened up a new area in the Duars, Bengal. A large collection was received from Bengal from Mr. H. Stevens, another collection from Assam came from Mr. Chas. Antram, whilst a third and very interesting lot came from Mr. Elton Bott of King Island, Mergui. To all of these collectors I tender my sincere thanks, for it is largely owing to their disinterested efforts that the dragonfly fauna of India is now so well known; the number of species in 1918 totalled only 160, but has now passed the figure of 500.

(Revision of Genus IDIONYX).

GENUS: IDIOPHYA gen nov.

Medium sized dragonflies belonging to the subfamily *Corduliinae*. Head very large, almost as large as the thorax; eyes globular, broadly contiguous;

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occiput very small; frons rounded, deeply grooved; vesicle swollen, rounded at summit, simple in both sexes so far as at present known. Prothorax small, completely concealed by the overhanging head, its posterior lobe simple, thorax comparatively small, metallic, broadly marked with yellow laterally; legs rather long and slim; hind femora extending to a little beyond the end of thorax and furnished with a row of rather widely-set, very tiny spines; tibiae furnished with moderately long fine hair-like spines. Tibial keels absent in the female.

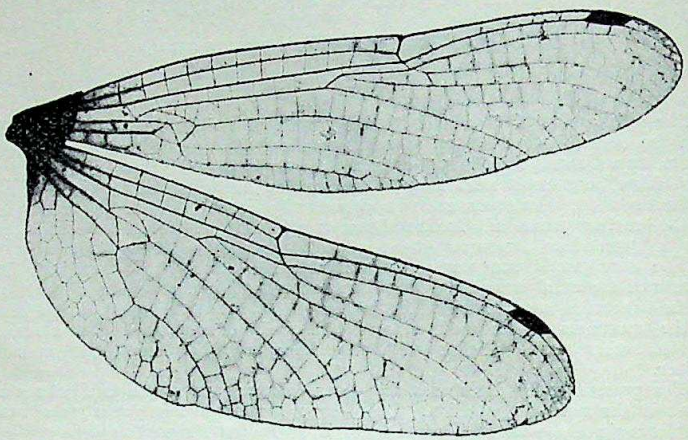

Fig. 1.—Wings of *Idiophya nilgiriensis* (Fras.) ♀.

Wings hyaline, tinted only at extreme base and variably enfumed with dull brown only in adults; reticulation moderately close, nodal index moderately high; hindwing much broader than fore; 1 cubital nervure in forewings, 2 in the hind where the subtrigone does not exist; anal loop sausage-shaped, made up of 9 to 10 cells; hypertrigone of forewing traversed once, that of the hind entire; discoidal triangles entire, *that of forewing four-sided,* the costal and distal sides usually widely separated; that of hindwing with the costal side convex and slightly longer than the basal and distal sides; subtrigone of forewing equilateral, entirely absent in the hind; discoidal field of forewing single-celled to the level of node; *Rspl* well developed in fore- and hind-wings, a single row of cells between it and *IRii; Mspl* absent; pterostigma very short, oblique at both ends, a little swollen at its middle, unbraced; membrane well developed.

Abdomen tumid at base, then cylindrical and constricted and again expanded towards the anal segments, where, in the female, it is markedly depressed; vulvar scale short, triangular, projecting but slightly from the apical end of segment 8; anal appendages of female shortly cylindrical.

Distribution.—Known only from South India and by one species which is riverine and submontane in its habits. This new genus is closely related to *Idionyx* but is more archaic and sharply differentiated by the broken character of the costal side of the discoidal triangle in the forewing, which recalls the more archaic members of the *Libellulinae* such as *Tetrathemis* or similar archaic genera of the *Corduliinae* such as *Pentathemis, Neophya* and *Cordulephya.* From the former it is separated by its much simpler venation, the single-celled subtrigone of forewings, only a single cubital nervure present in these wings, by the shorter anal loop and by the discoidal triangle of hindwing entire etc.; from *Neophya* it is separated by the narrower hindwing, this being enormously expanded in *Neophya;* finally from *Cordulephya,* the broader hindwing and the presence of an anal loop will serve to distinguish it, the fore and hindwings of that genus being of the same depth at base. *Idiophya* also differs from species of *Idionyx* by the shape of the abdomen which is expanded and

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compressed at the end in the female instead of markedly compressed and of even width as in *Idionyx;* the dorsum of segment 2 marked broadly with yellow is also foreign to *Idionyx*. Probably when the male is discovered we shall find that more characters for differentiation will be added to the above. In habits, *Idiophya* appears to be more retiring and solitary; when ovipositing, it retires deep into the scrub or enters dark caverns and deposits its ova in wet sand or mud. Male and larva unknown.

Genotype.—*Idiophya nilgiriensis* (Fras.).

Idiophya nilgiriensis (Fraser).

Phyllomacromia nilgiriensis Fras. *Journ. Bom. Nat. Hist. Soc.*, Vol. xxv, pp. 383, 384 (1918); Id. ibid., Vol. xxvii, pp. 687, 688 (1921).

Idionyx nilgiriensis Fras. *Rec. Ind. Mus.*, Vol. xxvi, pp. 427, 460, 461 (*saffronata* nec *nilgiriensis*) (1924); Id. ibid., Vol. xxviii, pp. 196, 197, 198 (1926); Id. ibid., Vol. xxxiii, p. 447 (1931).

Female.—Abdomen 30-32 mm. Hindwing 32 mm. (Male unknown).

Head.—Labium dark brown; labrum bright citron or pale yellow bordered narrowly with blackish brown; clypeus glossy black; frons and vesicle dark metallic green; occiput black; eyes emerald green during life, paler above than below.

Prothorax brown; thorax metallic green with a narrow oblique pale yellow stripe on each side on middle of mesepimeron and a similar coloured stripe on the lower border of metepimeron; beneath pale yellow with a transverse stripe across the paired sclerites and a small obscure spot on the unpaired one. Legs yellow, femora black at distal ends, the anterior pair of tibiae also black; coxae yellow, this colour on the middle pair continued up a short distance on to thorax.

Wings hyaline palely tinted with golden yellow at the extreme base, in some specimens this area extends out nearly to the discoidal cells and in others, more adult, the whole of the wings are enfumed pale brown, this brown forming an areola around each cell of the wings, the cell middles being clear; membrane white; pterostigma black, very small, covering only 1 to 1½ cells; anal loop made up of 8 or 10 cells; discoidal cell in forewing four-sided; the costal and distal sides well separated; only a single row of cells between the beginnings of *IA* and *Cuii;* nodal index.—$\frac{6\text{-}12}{7\text{-}8}\,\frac{12\text{-}7}{8\text{-}6}$, $\frac{6\text{-}12}{8\text{-}8}\,\frac{13\text{-}6}{8\text{-}8}$.

Abdomen black; segment 2 with a crown-shaped citron yellow spot on middorsum, the base of the crown turned to the jugal suture and some obscure yellow markings extending outwards and apicalwards to join an incomplete yellow apical ring; segments 1 to 3 broadly yellow along the ventral borders. Vulvar scales small, triangular, not visible in profile. Anal appendages very small, shortly conical.

Distribution.—Known only from the Burliyar river, Nilgiri Hills. I have taken seven specimens in all of this interesting species, all being females and all taken within a small area during the months of June and July.

The type, now in the British Museum, was taken in 1917 and five more specimens were taken at the same spot in 1920 and 1921. I searched in vain for it during June 1931. The disastrous floods of 1923 tore the bottom out of the Burliyar river and swept most of the fauna away; several species once common there, such as *I. burliyarensis*, have totally disappeared. However, last year, 1932, I was fortunate enough to secure a seventh female quite near the old haunts so that the species still exists and the male may yet come to light. This was the only specimen seen although I repeatedly visited the river.

As mentioned above, the habits of *Idiophya nilgiriensis* are rather different from species of *Idionyx* as it keeps to close undergrowth along the banks of the river, threading its way with a very erratic and rather swift flight among the scrub or giant colladiums which grow in patches in marshy spots along the borders of the Burliyar. In flight it is remarkably invisible and a most bewildering insect to follow. The specimen I took in 1932 was seen and lost sight of four times before I took it with what was a blind cut at it with the

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net. It deposits its eggs in wet sand or mud, either in dark caverns among the rocks or under shelter of the colladiums which rise from a bed of black slimy mud.

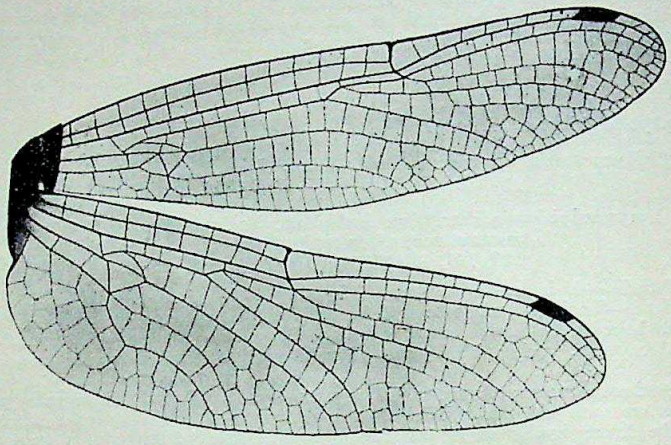

Fig. 2.—Wings of *Idionyx saffronata* Fras. ♂.

Genus: IDIONYX Hagen-Selys.

Idionyx Hagen, Zool. Bot. Ges. Wien. xvii, p. 58 (1867); Brauer, ibid., xviii, pp. 370, 742 (1868); Selys, C. R. Soc. Ent. Belg. xiv, p. 6 (1870); Id. Bull. Acad. Belg. (2) xxxi, p. 519 (1871); Id. ibid. xlv, p. 212 (1878); Kirby, Cat. Odon. p. 56 (1890); Karsch, Ent. Nach. xvii, p. 27 (1891); Martin, Cat. Coll. Selys, Cordulines, pp. 57, 80 (1906); Ris, Suppl. Ent. No. 1, p. 79 (1912); Fras. Journ. Bomb. Nat. Hist. Soc. Vol. xxvii, p. 688 (1921); Id. Rec. Ind. Mus. Vol. xxvi, p. 458 (1924); Id. ibid. Vol. xxviii, pp. 195-200 (1926); Id. ibid. Vol. xxxiii, p. 453 (1931).

Dragonflies of medium size belonging to the subfamily *Corduliinae*. Head very large, as large as the thorax; eyes globular, broadly contiguous; occiput very small; frons and vesicle metallic, the latter often of bizarre shape in the female. Prothorax small, posterior lobe simple; thorax small, metallic marked with yellow; legs long and slim, the hind femora extending to a little beyond the posterior end of thorax and armed with numerous closely-set, minute imbricated spines and two rows of fine hair-like spines on all three pairs. Tibial spines numerous, fine, long and closely-set; all tibiae with a membranous keel on the flexor surface, a long keel on the posterior pair but only a short distal one on the middle and anterior pairs of tibiae; tibial claws bifid. Keels absent in the females, otherwise the armature similar.

Wings hyaline, often saffronated at the bases in the females, rarely so in the males; occasionally deeply enfumed in the females, reticulation moderately close; bases shallowly notched in the male, broadly rounded in the female; hindwing much broader than the fore, especially in the female; 1 or 2 cubital nervures in forewings, only 1 in the hind; anal-loop shorter than in the *Libellulinae* and without the toe-like prolongation, of 4 to 7 cells in the male, 8 to 10 in the female; nodal index moderately high; hypertrigones traversed once or twice in the forewings, only once or entire in the hind; discoidal triangles and subtrigones entire; discoidal triangles in forewings equilateral, smaller than the adjacent subtrigone, its base situated far distad the level of the arc; in the hindwings, the distal and costal sides longer than the basal, the base slightly distad the level of the arc; sectors of arc in both fore and hindwings fused for a long distance; discoidal field in forewing made up of a

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single row of cells to beyond the level of the node and sometimes almost to border of wings; a single or a double row of cells for about 5 cells in the hindwing; 2 rows of postanal cells in forewings. Pterostigma short, covering 1½ to 3 cells, unbraced.

Abdomen cylindrical in the male, markedly compressed in the female, tumid at base and again somewhat expanded at the anal end; segment 10 in the male with a more or less marked carina or ridge which in some species is produced into a robust spine. Anal appendages of male markedly variable and complex, the superiors occasionally spined beneath, the inferiors usually more or less trifid or with lateral spines. Genitalia of male very homogeneous; lamina depressed, anterior hamules fine stilet-shaped organs, the posterior tumid and bearing a robust strongly curved spine; vulvar scale abbreviated, scoop-shaped, shortly triangular and projecting rather markedly in profile.

Distribution.—The Western Ghats of India, Himalayas, Assam, Burma, Java, Sumatra, Borneo, S. China, Malaysia and the Philippines.

Since I described the four species in Part X of this monograph, a mass of material has been collected and about 150 specimens including 16 species, have been available for this paper. Much also has been learnt of the habits of several species, more especially of those found in the Western Ghats which I have been able to study first-hand. Some species are gregarious and I have seen as many as thirty in one group engaged in a dancing flight like that of a swarm of midges. Both sexes mingle without any attempts at pairing, an action which I have only observed on two occasions in spite of great numbers observed. A male was seen to pounce from nowhere on to a solitary female and the two then flew swiftly down a deep culvert towards the bed of the major stream. *I. burlyarensis* has been seen frequently flying swiftly over the small pools in beds of streams apparently searching for females. Most species are found flying at about ten to thirty feet in the air in forest ridings and glades, others toward dusk descend and fly low over dirty cattle-standings on ghat roads where they probably find an abundance of food. All species breed in torrential mountain streams and none has been observed below an altitude of 2,000 ft.; the larva is distinctly Libelluline in character. The eggs are not laid direct into the parent stream but into seepages along their borders, ova being often laid direct on damp sand. Genotype.—*I. optata* Selys.

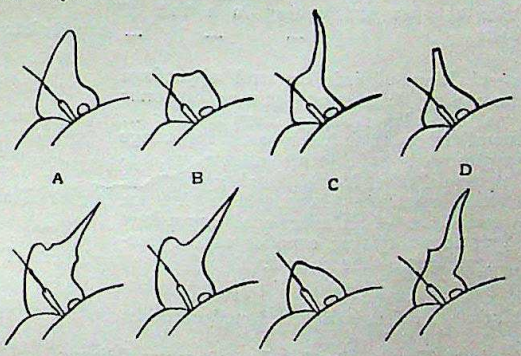

Fig. 3.—Vesicle seen in profile of the females of.—A. *I. burliyarensis* Fras B. *I. optata* Selys. C. *I. unguiculata* Fras. D. *I. intricata* Fras. E. *I. galeata* Fras. F. *I. rhinoceroides* sp. nov. G. *I. travancorensis* Fras. H. *I. corona* Fras.

Key to the males of genus *Idionyx.*

1. { Humeral yellow stripe present on thorax ... ... 2.
   { Humeral yellow stripe absent on thorax ... ... 5.

2. { Segment 10 without a dorsal spine ... *selysi* Fras.
   { Segment 10 with a long erect dorsal spine ... ... 3.

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3.	Superior anal appendages with a medio-ventral snipe ... ... 4.	
	Superior anal appendages without such a spine	*intricata* Fras.
4.	Inferior anal appendage with a very small lateral spine surmounting the posterior angle of a quadrate projection ...	*optata* Selys.
	Inferior anal appendage with a very robust simple lateral spine	*stevensi* Fras.
5.	Labrum bright citron yellow narrowly bordered with black ... ... 6.	
	Labrum entirely black	*minima* Fras.
6.	Superior anal appendages with a row of teeth beneath basal half ... ... 7.	
	Superior anal appendages naked beneath ... ... 8.	
7.	Inferior anal appendage trifid, the apical portion very narrowly and deeply emarginate, sloping strongly up at an angle to the basal portion	*galeata* Fras.
	Inferior anal appendage trifid, the apical portion broad and shallowly emarginate, directed straight back in line with the basal portion	*saffronata* Fras.
	Inferior anal appendage trifid, the apical portion very narrowly and deeply emarginate, directed straight back in line with the basal portion	*travancorensis* Fras.
8.	Superior anal appendages simple at apices; inferior variable ... ... 9.	
	Superior anal appendages curled spiral-wise at apex and ending in a tuft of hairs	*unguiculata* Fras.
9.	Lateral lobes of inferior anal appendage mere tiny thin erect spines; superior anal appendages shorter than inferior ...	*burliyarensis* Fras.
	Lateral lobes of inferior anal appendage represented by a mere angulation upwards of the lateral border; superior anal appendage shorter than inferior	*corona* Fras.
	Lateral lobes of inferior anal appendage long robust spines; superior anal appendages longer than inferior	*imbricata* Fras.

(The males of *I. rhinoceroides* and *nadganiensis* are unknown.)

Key to the females of genus *Idionyx*.

1.	Vesicle produced and occasionally complex ... ... 2.	
	Vesicle simple, rounded or slightly notched at apex ... ... 6.	
2.	Humeral thoracic stripe present; vesicle surmounted by four tubercles ...	*optata* Selys.
	Humeral thoracic stripe absent ... ... 3.	
3.	Vesicle produced as a simple spine or horn ... ... 4.	
	Vesicle produced as a complex horn ... ... 5.	

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4.	Vesicle a short blunt horn	*travancorensis* Fras.
	Vesicle a short tapering horn with bifid apex	*intricata* Fras.
	Vesicle a short cone surmounted by a long fine acutely pointed spine	*unguiculata* Fras.
	Vesicle an elongate bluntly pointed curved cone	*burliyarensis* Fras.
5.	Vesicle a short cone with a sinuous spine extending back from its apex	*coronata* Fras.
	Vesicle a short cone with a long simple straight spine extending back from its apex	*rhinoceroides* sp. nov.
	Vesicle a short cone surmounted by an obtuse tubercle with a tent-shaped spine extending back from its apex	*selysi* Fras.
6.	Humeral thoracic stripe present	7.
	Humeral thoracic stripe absent	9.
7.	Bases of wings broadly tinted with golden amber to the level of distal end of discoidal cells; vesicle conical	*stevensi* Fras.
	Bases of wings uncoloured or but slightly so at extreme bases; vesicle blunt, slightly notched	8.
8.	All tibiae bright citron yellow; pterostigma short, covering less than 2 cells; abdomen shorter than wings	*selysi* Fras.
	Only the hind tibiae yellow; pterostigma long, covering 2 to 3 cells; abdomen longer than the wings	*nadganiensis* Fras.
9.	Labrum entirely black	*minima* Fras.
	Labrum bright citron yellow narrowly bordered with black	10.
10.	Bases of wings broadly tinted with golden amber to or beyond the level of distal end of discoidal cells	*saffronata* Fras.
	Bases of wings not tinted or only at extreme bases	*imbricata* Fras.

Group I.—*optata*.

Humeral yellow stripe present in both sexes; superior anal appendages of male shorter than the inferior and possessing a ventral spine; female with abdomen markedly compressed and not dilated at the end; vesicle simple or specialized; wings variably tinted with golden yellow at the base.—*optata, yolanda, carinata, intricata, stevensi* and *nadganiensis*.

Group II.—*corona*.

Humeral stripe absent in both sexes; superior anal appendages as long as or longer than the inferior and without a ventral spine; no dorsal spine to segment 10; female with abdomen markedly compressed and not dilated at the end; vesicle specialized; wings not tinted at base or only at the extreme base. —*corona, burliyarensis, unguiculata* and *rhinoceroides*.

Group III.—*dohrni*.

Characters similar to the last group save that the female vesicle is simple and the female of *imbricata* has a vestigial humeral stripe present.—*montana, imbricata, philippa* and *dohrni*.

Group IV.—*saffronata*.

Humeral stripe absent in both sexes; superior anal appendages longer than the inferior and with a row of minute teeth on the ventral surface; female

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with vesicle simple except in *galeata* and with the wings usually broadly tinted at the base.—*galeata, saffronata, minima* and *travancorensis.*

Group V.—*claudia.*

Humeral stripe absent in both sexes; superior anal appendages of male of the same length as the inferior, short, simple and Libelluline in character; female with abdomen markedly compressed, not dilated at the end; wings broadly tinted at base; vesicle simple; male with robust spine on dorsum of segment 10.—*claudia.*

Group VI.—*selysi.*

Humeral stripe present in both sexes; female with abdomen markedly compressed and not dilated at the end; wings not tinted at base; vesicle simple; male with a long tapering spine on dorsum of segment 10; superior anal appendages slightly longer than inferior and without a ventral spine.—*selysi.*

Idionyx saffronata Fraser.

Idionyx saffronata Fras. Rec. Ind. Mus. Vol. xxvi, pp. 427, 458-460 (1924); Id. ibid. Vol. xxviii, pp. 196, 197 and 198 (1926); Id. ibid. Vol. xxxiii, pp. 447, 456 (1931).

Male.—Abdomen 33 mm. Hindwing 34 mm.

Head.—Labium brownish yellow bordered diffusely with brown; labrum bright chrome yellow bordered with black; ante- and post-clypeus glossy black; frons dark metallic blue or violet; vesicle dark metallic violet, tumid, nearly as broad as frons, rounded above; occiput black; eyes emerald green.

Prothorax blackish brown. Thorax brilliant metallic green with a narrow medial oblique stripe on each side and the posterior half of the metepimeron yellow. Beneath striped alternately black and yellow, two stripes of each colour.

Legs black, the middle and anterior pairs of femora yellow on the inner sides; tibiae yellow striped with black on the flexor surface.

Wings hyaline, very palely enfumed or saffronated as far out as a little beyond the tornus, more deeply so in the subcostal and cubital spaces and anal triangle; pterostigma black, small, covering 1½ cells; membrane cinereous; anal-loop made up of 7 to 8 cells; nodal index—$\frac{7-13}{9-8}\,\frac{13-8}{8-9}$.

Abdomen black, the first and second segments marked narrowly along the ventral borders with citron yellow; segments 7 to 10 bordered with bright yellow beneath; segment 10 strongly keeled but without a dorsal spine.

Anal appendages black; superiors tapering from base to apex, flattened on the inner side, apical third angled obtusely inward; an irregular row of minute teeth on the ventral surface near the base of the appendage; inferior directed straight back, the apex not curled up, but deeply trifurcate, the lateral lobes robust, slightly upturned widely divaricate spines, the middle lobe excavate, broad at apex and with a slight prominence at its middle. Genitalia:—lamina broadly and deeply excavate, an emarginate plate projecting from its free border; hamules very tumid, chelate, the outer claw tumid, short, the inner of the same length, prolonged as a long curled spine; lobe rounded, broad, yellow and coated with long yellow hairs.

Female.—Abdomen 34 mm. Hindwing 35 mm.

Closely similar to the male, but differing as follows:—wings hyaline or more or less deeply enfumed especially towards the apices, the bases tinted with deep golden yellow as far out as the level of the outer end of trigones and for the whole breadth of forewings and nearly to the apex of anal-loop in the hind; pterostigma black, small, unbraced, covering 2 cells; nodal index.—$\frac{7-13}{9-8}\,\frac{12-7}{8-9}$, $\frac{7-15}{9-9}\,\frac{14-6}{9-9}$.

Abdomen glossy black, the central lateral borders of segments 1 to 3 and special borders of 1 and 2 moderately broadly citron yellow. Vulvar scale very prominent as viewed from the side, acute and strongly keeled.

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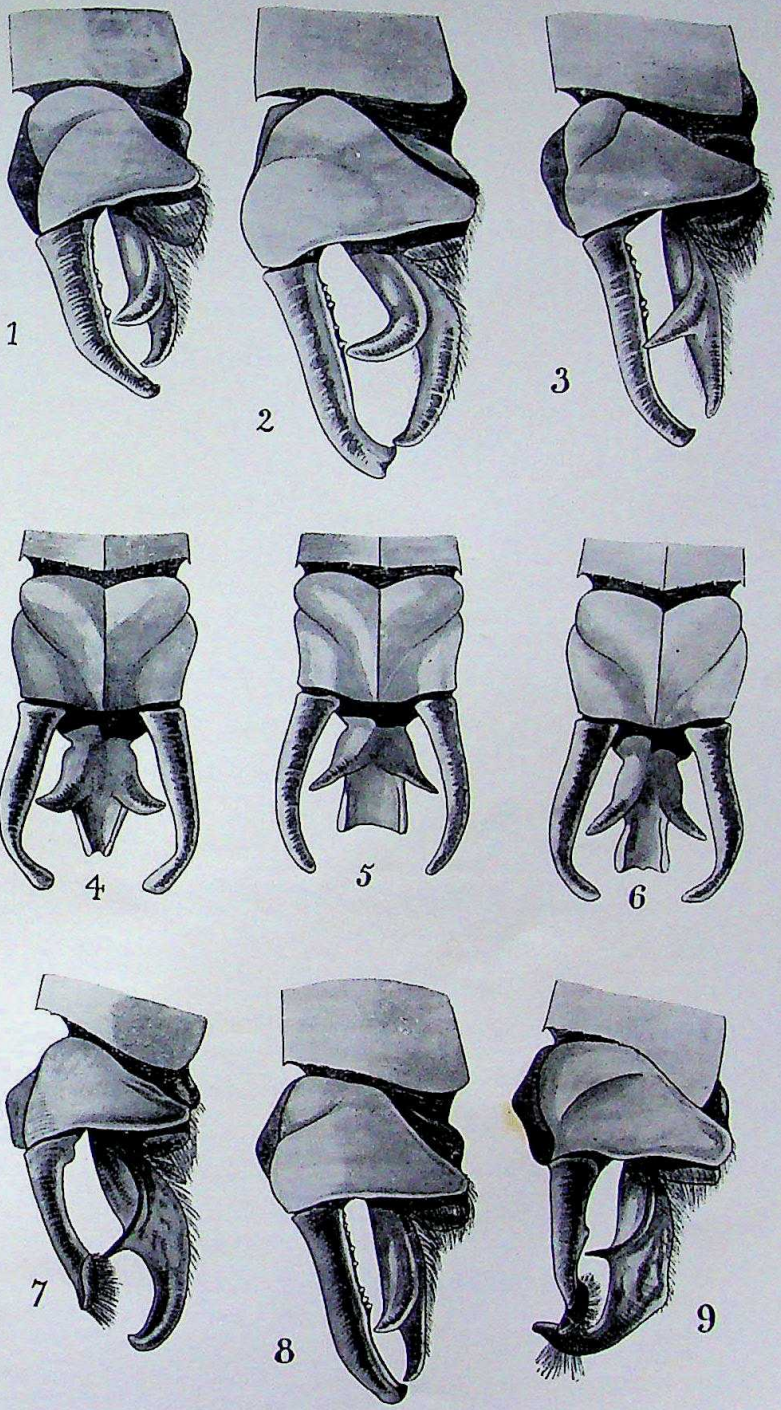

ANAL APPENDAGES OF DRAGONFLIES. (For explanation of plate see end of article.)

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Distribution.—Coorg at altitudes of about 3,000 ft. and upwards, Annaimallai Hills, S. Malabar and Travancore; common in the first of these localities but far less so in the others. In Coorg, during May and June it was common to see swarms of these insects engaged in what appeared to be a nuptial flight; 30 or more would be seen dancing up and down in the air in a forest clearing or over the forest roads. They fly only during sunlight; even a cloud passing over being sufficient to send them off into the jungle for shelter.

The broadly saffronated wings of the female together with the simple shape of the rounded vesicle will serve to distinguish it from other females except *minima*, which latter however is much smaller and has the labrum entirely black. The male is distinguished by the specific shape of its inferior anal appendage, the middle lobe of which is very broad and directed straight back.

Type male and allotype female have been deposited in the British Museum. May and June are the months to seek this insect.

Idionyx travancorensis Fraser.

Idionyx travancorensis Fras. Rec. Ind. Mus. Vol. xxxiii, pp. 447, 455, 456 (1931).

Male.—Abdomen 32 mm. Hindwing 32 mm.

Head.—Labium blackish brown, paler laterally; labrum citron yellow broadly bordered with black; clypeus and genae black; frons anteriorly and above metallic bluish green; vesicle metallic bluish violet; occiput black; eyes emerald green.

Prothorax blackish brown; thorax metallic green, humeral stripe absent: laterally a narrow oblique stripe at the level of the spiracle and another on the hinder border of metepimeron; beneath black bordered with yellow and with a stripe of paler yellow at its middle. Legs black, tibiae yellow on extensor surface.

Wings hyaline very palely and uniformly tinted with yellow. Pterostigma black, covering 1½ cells, short; membrane cinereous; anal-loop made up of 7 to 8 cells; nodal index.—$\frac{7-12}{8-8}\Big|\frac{12-7}{8-9}$.

Abdomen black, unmarked save for the ventral border of segment 2 and a narrow apical stripe on the same segment yellow; segment 10 strongly carinated but without a dorsal spine.

Anal appendages black; superiors shaped very similarly to those of *I. saffronata* but with the apex angulated more abruptly down. The minute ventral spines present as two groups of 2 or 3 respectively. Inferior appendage differing more widely, its apex tapering to an obtuse emarginate point less than half the breadth of that of *I. saffronata;* the lateral robust spines are much stouter and turned more abruptly outward. Viewed in profile, this appendage however is strikingly like that of *I. saffronata.*

Female.—Abdomen 32-35 mm. Hindwing 34-35 mm.

Resembles the male closely but differs by the colour of the wings and sexual morphology. Vesicle cone-shaped, the cone blunt and differing rather strongly from that of *I. burliyarensis.* The abdomen depressed and fusiform in shape towards the anal segments and somewhat similar to that of the female of *I. nilgiriensis.*

Wings burnt brown throughout, the cell-middles paler giving a stippled appearance to the wing; the bases deeply saffronated or golden yellow as far out as the level of trigones; other details of the wings similar to the male. Vulvar scale similar to that found in *I. saffronata.*

Distribution.—Travancore and the Annaimallai Hills at altitudes of 3,000-4,000 ft. during May and June. The male is easily distinguished by the shape of its inferior anal appendage and the female by its saffronated wings and conical vesicle. Habits similar to those of *I. saffronata* with which I found it in company on the ghat road leading from Munnar, Travancore to Cochin State. Type and allotype female at present in my own collection. Closely related to *I. saffronata, minima* and *galeata.*

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Idionyx minima Fraser.

Idionyx minima Fras. Rec. Ind. Mus. Vol. xxxiii, pp. 447, 453-455 (1931).

Male.—Abdomen 27 mm. Hindwing 30 mm.

Head.—Labium, labrum, clypeus and genae black, unmarked; frons anteriorly and above metallic prussian blue; vesicle metallic blue; occiput black; eyes emerald green.

Prothorax blackish brown; thorax metallic green changing on the lower parts of sides to metallic blue; humeral stripe absent but a narrow oblique citron yellow stripe on each side at level of the spiracle and a similar stripe on the posterior border of metepimeron. Beneath brownish black encircled with yellow. Legs black, tibiae striped with yellow on extensor surface.

Wings hyaline, the bases very palely saffronated as far out as 2 cells distad the trigones; pterostigma black, very short, twice as long as broad, only covering 1 to 1½ cells; anal-loop made up of 7 cells; membrane cinereous; nodal index.—$\frac{7\text{-}12}{7\text{-}8}\left|\frac{13\text{-}6}{9\text{-}6}\right.$.

Abdomen black, unmarked; segment 10 strongly keeled but without a dorsal spine. Anal appendages black; superiors rather longer than segment 10, broad at base, tapering as far as apex, the distal half curved upwards at an obtuse angle and also downward, the apex ending in a short point; a row of minute teeth on the ventral surface of the basal two-thirds as in *I. saffronata*.

Inferior appendage shorter than superiors, deeply trifid and shaped like a bird's claw, the middle lobe very broad and only shallowly emarginate as viewed from above and its apex curled rather strongly up, the lateral spines rather narrow and widely divaricate.

Female.—Abdomen 29-31 mm. Hindwing 30 mm.

Marked similarly to the male. Differs only in sexual characters and in the colouring of the wings which are a deep golden amber as far out as 2 cells beyond the trigones. Vesicle simple, rounded and very slightly notched above.

Distribution.—From Travancore only. I took a few specimens of both sexes flying among tea off the Munnar ghat road during June. It is the smallest species of the genus and is closely related to the two foregoing species and to *I. galeata* by the shape of the anal appendages and especially that of the superiors with the characteristic row of minute teeth beneath near the base. The glossy jet black labrum will serve to distinguish it at once from all of these species, this character applying equally to both sexes.

Idionyx galeata Fraser.

Idionyx galeata Fras. Rec. Ind. Mus. Vol. xxvi, pp. 517, 519 (1924); Id. ibid. Vol. xxviii, pp. 196, 197, 198 (1926); Id. ibid. Vol. xxxiii, p. 447 (1931).

Male.—Abdomen 35 mm. Hindwing 35 mm.

Head.—Labium, labrum and face dark blackish brown; frons in front and above brilliant metallic green; vesicle metallic bluish green or violaceous; occiput black; eyes emerald green.

Prothorax blackish brown; thorax metallic green with a golden reflex laterally; humeral stripe absent; laterally an oblique citron yellow stripe bordering the antero-lateral suture posteriorly and a similar stripe on the lower posterior border of metepimeron. Beneath blackish striped with yellow obscurely, the paired sclerites black.

Legs black, anterior and middle coxae yellow; tibiae yellow on extensor surface; the keel on hind tibiae with an interruption in its continuity near the distal end.

Wings hyaline, palely and uniformly tinted with yellow; the neuration sometimes surrounded with an areola of brownish, the cell-middles being clear; pterostigma black, covering only 1¼ cells; membrane dark cinereous; anal loop made up of 8 cells; nodal index.—$\frac{8\text{-}14}{9\text{-}9}\left|\frac{14\text{-}8}{9\text{-}9}\right.$, $\frac{8\text{-}13}{10\text{-}9}\left|\frac{14\text{-}7}{9\text{-}9}\right.$.

Abdomen black, the borders of segment 2 ventrally yellow as also a fine incomplete annule on the apical border. Anal appendages black; superiors

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rather longer than the inferior, subcylindrical and tapering to apex which is a little dilated and turned inwards and a little downwards as viewed from the side; a row of fine teeth along the ventral border especially near the base. Inferior broadly and deeply trifid, shaped like an eagle's talon, the apex narrowly emarginate and turned up very steeply; the lateral lobes large robust spines slanted almost straight upward.

Female.—Abdomen 37 mm. Hindwing 37 mm.

Closely resembles the male save for its sexual characters; differs as follows:—vesicle remarkably specialized, its apex obtuse and with a protuberance behind it shaped like a minaret ending in a fine spine; prothorax a paler brown; thorax without the yellow bordering to the metepimeron; ventral borders of segments 2 and 3 citron yellow; wings hyaline, the bases palely tinted with golden yellow as far out as the third antenodal nervure in the forewing and the second in the hind. Occasionally females are taken with the tinted area extending as far out as the outer end of discoidal triangles in the hindwing and the whole wing more or less deeply enfumed or stippled with warm brown. The female differs from the male and from most other species of the genus by having a double row of cells between the origins of *IA* and *Cuii* in the hindwing.

Distribution.—Coorg and S. Kanara. I took a number of both sexes at Katlikad Estate near Mercara but never found it elsewhere in Coorg. Mr. S. A. Souter found it swarming at about 4,500 ft. on the slopes of Kudremukh, S. Kanara about the middle of June. Most of the specimens were flying quite low over coffee bushes or along the borders of ferny banks. The male is easily distinguished by the shape of its anal appendages and the female by the unique shape of its vesicle.

Idionyx burliyarensis Fraser.

Idionyx corona race *nilgiriensis* Fras. Mem. Dept. Agric. India, Vol. vii, No. 7, pp. 65, 66 (1922).

Idionyx corona burliyarensis Fras. Rec. Ind. Mus. Vol. xxvi, pp. 427, 461, 462 (1924).

Idionyx burliyarensis Fras. Rec. Ind. Mus. Vol. xxviii, pp. 196-198 (1926); Id. ibid. Vol. xxxiii, p. 447 (1931).

Idionyx corona fulvia Fras. Rec. Ind. Mus. Vol. xxvi, pp. 516, 517 (1924).

Male.—Abdomen 35 mm. Hindwing 33 mm.

Head.—Labium bright citron yellow; labrum citron yellow heavily bordered with dark brown; clypeus dark metallic blue; frons broadly rounded, dark metallic green; vesicle dark metallic blue; occiput black; eyes emerald green during life.

Prothorax brown; thorax metallic emerald green with a golden reflex; humeral stripe absent; laterally a moderately broad citron yellow stripe obliquely traversing the spiracle and a similar stripe on the posterior and lower border of metepimeron; beneath yellow, the paired and unpaired sclerites black with a bluish reflex.

Legs black; tibiae paler on extensor surface; the anterior pair with a keel on the outer third, the hinder with a complete keel.

Wings hyaline, untinted save in very adult specimens which may be slightly enfumed; pterostigma black, covering 2½ cells; anal-loop made up of 8 cells; hypertrigones traversed, those of the forewing often twice; usually 2 cubital nervures in forewings, 1 in the hind; membrane palely cinereous; nodal index.—

$$\frac{6\text{-}13\,|\,14\text{-}8}{9\text{-}9\,|\,9\text{-}10}.$$

Abdomen black, the ventral borders of segments 1 to 3 yellow as also the intersegmental joint between segments 2 and 3. Anal appendages black; superiors much shorter than the inferior, subcylindrical, rather flattened towards the apex which is bevelled beneath and furnished with a tuft of long coarse golden hairs; inferior very massive, its apex curled strongly up and narrowly emarginate, its lateral spines very small, finely pointed and directed straight up; the appendage deeply hollowed out above in its apical half. Genitalia very similar to that of *I. saffronata*.

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(This sex has not been described heretofore.)

Female.—Abdomen 35 mm. Hindwing 35 mm.

Closely similar to the male, differing only in sexual characters and a few minor points. The eyes are emerald green capped with brown; the labrum entirely yellow and there is also a small triangular spot of yellow on the anteclypeus. The wings have amber tinted streaks or rays in the subcostal and cubital spaces and they are more or less enfumed according to age. Anal-loop made up of 8 to 10 cells; nodal index.— $\frac{9\text{-}17}{10\text{-}10}\,\frac{15\text{-}8}{10\text{-}10}$, $\frac{8\text{-}14}{10\text{-}8}\,\frac{13\text{-}8}{9\text{-}10}$. The vesicle is specialized and shaped like the horn of a rhinoceros, its apex prolonged, curling back and bluntly acuminate. Abdomen with the ventral borders of segments 1 to 4 yellow, as also the intersegmental joints between 2nd and 3rd and 3rd and 4th segments. Vulvar scale shaped as in *I. saffronata*, prominent and projecting.

The race *fulvia* has the male similar to type but the females have the wings very deeply enfumed; in some this is a warm uniform reddish brown tint throughout but in others it is paler, but the basal marking is a rich maroon extending out fanwise as far as the outer end of discoidal triangles in both wings; the pterostigma is slightly longer and often covering 3 cells.

Distribution.—Coorg, S. Malabar, and rare in the Annaimallai Hills and Travancore. The race *fulvia* is confined to Coorg on the Sampaji Ghat road. *I. burliyarensis* used to be plentiful in the bed of the Burliyar river, Mettupalayam Ghat but has completely disappeared of late years since the disastrous floods of 1923, which tore the bottom out of the river and swept away its fauna. It is quite common in Coorg and the race *fulvia* is plentiful near Sampaji. The males appear on the wing about four in the afternoon and are found flying over the river bed, whilst the females hug the ground around villages or at spots where carts rest for the night; over these dirty cattle-standings an abundance of small flies and midges afford them all the food they need. The dark coloured wings render them almost invisible when flying low over the ground and their dancing erratic aery flight make them most difficult to capture. May and early June are the months in which they should be sought. The male is easily determined by the curious shape of its anal appendages, and the female equally so by its curious shaped vesicle. Type and allotype female in the British Museum.

Idionyx corona Fraser.

Idionyx corona Fras. Journ. Bom. Nat. Hist. Soc., Vol. xxviii, pp. 690, 691 (1921); Id. Mem. Dept. Agric. India, Vol. vii, No. 7, pp. 64, 65, pl. vii, fig. 5 (1922); Id. Rec. Ind. Mus., Vol. xxvi, pp. 427, 462 (1924); Id. ibid. Vol. xxviii, p. 197 (1926).

Male.—Abdomen 29 mm. Hindwing 30 mm.

Head.—Labium bright yellow; labrum citron yellow changing to pale brown at the border; anteclypeus with a triangular spot of citron yellow at its centre; postclypeus black; frons and vesicle metallic dark bluish green, the latter conical; occiput black; eyes emerald green.

Prothorax yellowish; thorax metallic green with a golden reflex, with only a vestigial humeral yellow stripe which is entirely concealed by the head; laterally a narrow oblique yellow stripe traversing the spiracle and another along the lower border of metepimeron; beneath yellow, the sclerites dark brownish black. Legs black, tibiae yellow on extensor surface; a short distal keel on anterior tibiae and a complete one on the posterior pair.

Wings hyaline tinted with pale golden yellow at base and diffusely so along the costal border nearly as far as pterostigma; the latter organ black, rather longer than usual, covering 3 cells; membrane pale brown; anal-loop with 8 to 9 cells; 2 cubital nervures in forewings, one in the hind; hypertrigones traversed twice in forewings, only once in the hind; nodal index, $\frac{8\text{-}13}{10\text{-}10}\,\frac{14\text{-}8}{10\text{-}11}$.

Abdomen black, segments 2 and 3 narrowly yellow along the ventral border; segment 10 prominently keeled. Genitalia closely similar to that of *I. saffronata*. Anal appendages black; superiors much shorter than inferior, subcylindrical, the end bevelled beneath and bearing a few long hairs; seen laterally

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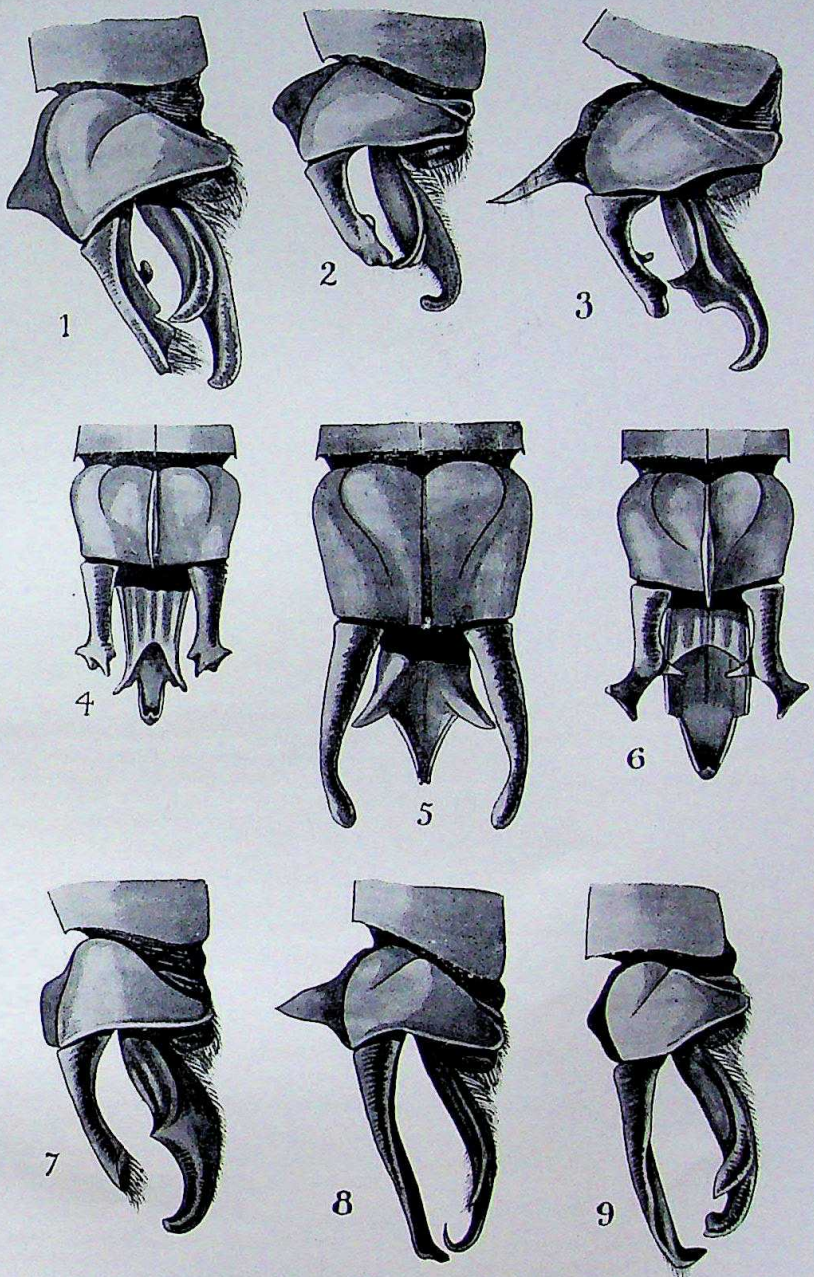

ANAL APPENDAGES OF DRAGONFLIES. (For explanation of plate see end of article.)

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this appendage is curved gently downwards; inferior very similar to that of *I. burliyarensis* but the lateral spines are entirely missing or merely represented by a lateral angulation of the appendage.

Female. Abdomen 32 mm. Hindwing 38 mm.

Closely similar to the male in colour and markings, the labrum bordered with dark brown and the anteclypeus without the central triangular yellow spot; vesicle markedly specialized, prolonged into an elevated spine shaped like the spout of a tea-pot, this spine springing from the posterior aspect of the apex of the vesicle; wings hyaline but with a dark brown areola surrounding all the neuration, the cell-middles being clear; the base of all wings tinted with golden yellow, this colour extending also along the costa as far as the pterostigma; pterostigma black, covering 2½ cells; membrane white changing to brown posteriorly; anal-loop made up of 11 cells; hypertrigones traversed once in forewings, entire in the hind; nodal index.— $\frac{8\text{-}13}{9\text{-}9}\Big|\frac{12\text{-}7}{9\text{-}9}$.

Abdomen and legs similar to the male; vulvar scale prominent, triangular and projecting.

Distribution.—Only a single pair of this insect is known, the type being a female from the Bababuddin Hills, Mysore, taken June 1915. The male allotype is in my own collection and was taken by Mr. C. A. Souter, I. C. S., at Shiradi, Saklespur Ghat, S. Kanara, 8-5-22. The species is a small one and varies from others by the male, as well as by the female, having the wings tinted with golden yellow along the costa nearly to the pterostigma. The inferior appendage without lateral spines will serve to distinguish it from others of the same group, whilst the female is easily distinguished by the shape of its unique vesicle. Type in the British Museum.

Idionyx rhinoceroides sp. nov.

Female.—Abdomen 32 mm. Hindwing 35 mm. (Male unknown).

Head.—Labium dark brown; labrum yellow diffusely and narrowly bordered with brown; clypeus black; frons and vesicle dark metallic violet or violaceous blue, the latter highly specialized, the base prolonged and blunt at apex from the back of which projects a very long straight tapering spine; occiput black; eyes emerald green.

Prothorax yellowish; thorax emerald metallic green, densely coated with long yellow hairs on dorsum; laterally a narrow oblique citron yellow stripe traversing the spiracle and another bordering the lower part of metepimeron; beneath yellow with oblique bluish black stripes on the paired sclerites and a triangular blackish brown spot on the unpaired. Humeral stripe absent.

Legs black; coxae yellow as also the extensor surfaces of all tibiae.

Wings hyaline but enfumed with warm reddish brown which forms a thick network corresponding to the neuration of the wings, the cell middles being clear; this brown colour deepest at the apices of hindwings; extreme bases tinted with golden yellow; pterostigma short, black, covering 1¼ cells only; hypertrigones traversed once in the forewings, entire in the hind; anal-loop made up of 12 to 13 cells; nodal index,— $\frac{7\text{-}11}{8\text{-}9}\Big|\frac{12\text{-}7}{9\text{-}8}$.

Abdomen black, the ventral borders of segments 2 and 3 citron yellow; vulvar scale triangular, projecting as in the last species.

Distribution.—South Malabar; a single female in my own collection collected at Dhoni near Mannarghat in May. Distinguished from all other species by the unique shape of its vesicle. It is evidently closely allied to the last species and probably belongs to the same group.

Idionyx unguiculata Fraser.

Idionyx unguiculata Fras. Rec. Ind. Mus. Vol. xxviii, pp. 20-4205 (1926).

Male.—Abdomen 32 mm. Hindwing 31 mm.

Head.—Labium pale brownish yellow; labrum citron yellow narrowly bordered with black; anteclypeus black with a yellow centre; postclypeus black with a bronzed reflex; frons and vesicle metallic bluish green; occiput black; eyes emerald green during life.

Prothorax brown, the posterior lobe yellowish; thorax metallic green; humeral stripe absent; laterally a narrow oblique citron yellow stripe travers-

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ing the spiracle and the lower border of metepimeron the same colour; beneath yellow, paired sclerites brownish black with bluish reflex. Legs black; tibiae paler on extensor surface, their keels similar to those of *I. corona*.

Wings hyaline, only the extreme bases palely tinted with golden yellow; pterostigma black, covering from 1½ to 2 cells; anal-loop made up of 9 to 10 cells; membrane greyish white; nodal index.— $\frac{7\text{-}13}{9\text{-}8}\left|\frac{14\text{-}7}{8\text{-}8}\right.$.

Abdomen black, the ventral borders of segments 1 to 3 and a fine mid-dorsal stripe extending from segment 1 to the middle of 3 citron yellow; the intersegmental nodes palely yellow from segments 3 to 7, the latter segment with a ventral tuft of yellow hairs as seen in most species; segment 10 strongly keeled, this keel almost amounting to a dorsal spine. Anal appendages black; superiors as long as segments 9 and 10, subcylindrical, tapering slightly towards the apex which has a spiral twist from within downwards and out, the apex of the spiral bearing a tuft of coarse yellow hairs. Inferior appendage considerably longer and of much heavier build, the basal half broad and deep and directed almost straight back on a horizontal plane, the apical portion curled rapidly and strongly up and tapering to a fine point; deeply grooved and hollowed out above and with a small upright spine at its middle on each side perched on the thin lateral borders. Genitalia similar to that of *I. saffronata*.

Female.—Abdomen 31 mm. Hindwing 28 mm.

Very similar to the male, differing in sexual characters and the following points:—vesicle markedly specialized, produced into a long horn somewhat like that seen in *I. corona* but its point recurved forwards instead of backwards and not hollowed out in front; a short vestigial humeral stripe completely obscured by the head; wings with dark golden yellow rays in the subcostal and cubital spaces, the intervening parts more palely tinted as far distal as the 2nd antenodal nervure; in tenerals this tinting is deeper and more extensive outwards. Adults also have the whole of the wing membrane palely enfumed; there are 2 rows of cells between *IA* and *Cuii* in the hindwing at their commencement instead of only 1 row found in the male; anal-loop with 9 to 11 cells; nodal index.— $\frac{8\text{-}12}{9\text{-}8}\left|\frac{14\text{-}7}{8\text{-}8}\right.$, $\frac{7\text{-}13}{8\text{-}8}\left|\frac{12\text{-}8}{7\text{-}10}\right.$, $\frac{5\text{-}13}{8\text{-}8}\left|\frac{12\text{-}6}{7\text{-}9}\right.$. Vulvar scales not differing from the last species.

Distribution.—Maymyo, Upper Burma. A single male and three females collected by Col. F. W. Wall, I.M.S., are now in my collection. The male is easily distinguished by the spiral twist of the apex of the superior appendages and by the tuft of yellow hairs on the same; the female may be distinguished by the shape of its vesicle and also by its vestigial humeral stripe.

Idionyx imbricaita Fraser.

Idionyx imbricata Fras. Rec. Ind. Mus. Vol. xxviii, pp. 197, 198, 205, 206 (1926).

Male.—Abdomen 28 mm. Hindwing 30 mm.

Head.—Labium bright yellow; labrum bright citron yellow narrowly bordered with black; anteclypeus black with a small triangular spot of citron yellow at its middle confluent with the yellow on labrum; postclypeus black; frons and sides of latter metallic bluish green; vesicle blue metallic; occiput black; eyes emerald green.

Prothorax blackish brown, posterior lobe bright yellow. Thorax metallic green or bluish green with a golden reflex; humeral stripe absent; laterally a narrow oblique median citron yellow stripe and the lower posterior half of metepimeron of the same colour; beneath yellow with the paired and unpaired sclerites bluish black. Legs black; the two posterior pairs of tibiae bright yellow, the anterior pair of the same colour on the outer side; tibial keels on anterior pair extending nearly half the length of limb, and for four-fifths the length of tibiae on the posterior pair.

Wings hyaline, bases palely tinted with golden yellow as far distad as the discoidal triangles; anal-loop made up of 9 to 10 cells; pterostigma black, covering only 2 cells; nodal index.— $\frac{6\text{-}12}{9\text{-}8}\left|\frac{12\text{-}7}{9\text{-}9}\right.$.

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Abdomen black; segments 1 and 2 with a broad middorsal bright yellow stripe extending from base to apex; segment 3 with a similar but finer stripe, whilst all three are yellow along the ventral borders, as also are segments 7 to 9 along the lower border. Segment 10 with a blunt middorsal keel not amounting to a spine.

Anal appendages black; superiors longer than inferior, subcylindrical, directed straight back but the extreme apex abruptly turned downwards and slightly inwards; the appendage twisted on itself so that the external surface ultimately comes to look upwards and inwards; inferior appendage more massive, deeply trifid, the apical median portion curled strongly upwards, pointed at the end and tumid immediately before this point above; the outer lobes robust spines, directed slightly upwards, backwards and outwards.

Female.—Abdomen 31 mm. Hindwing 33 mm.

Very similar to the male save for sexual characters; the postclypeus yellowish; vesicle simple, rounded as in the male; a vestigial humeral stripe present but which is entirely concealed by the overhanging head; legs blackish brown.

Wings hyaline, brightly tinted with golden-yellow at the extreme base; anal-loop with 10 cells; 2 cubital nervures in the hindwing; all hypertrigones traversed once; pterostigma small, covering 2 to 2½ cells; only a single row of cells between the commencements of *IA* and *Cuii* in the hindwing as in the male; nodal index.— $\frac{8\text{-}13}{10\text{-}9} \Big| \frac{13\text{-}8}{9\text{-}10}$.

Abdomen black; segments 2 and 3 with the middorsal ridge narrowly yellow as also the joint between the two segments; ventral borders of segments 2, 3, 7 and 8 yellow. Vulvar scale not differing markedly from others of the genus but rather shorter and obtuse at apex.

Distribution.—Reported only from Shillong, Assam from June to August at an altitude of 6,000 ft. Type in the British Museum, allotype female in the Morton collection. (In the original description it was stated that the female was unknown although this sex was actually described; the mistake arose from the latter description being added later during correction of the proofs and without deleting the former note.) This species is closely related to *I. dohrni* by the shape of its appendages etc. The female may be determined from others by the vestigial humeral stripe combined with a simple vesicle, and from *I. dohrni*, from Borneo, by the wings less tinted with yellow; the male is easily distinguished from all other Indian species by its long attenuated appendages, much longer than the inferior, whilst it differs from *I. dohrni* by the shape of the inferior appendage, more robust, the apex not ending in a fine prolonged spine and the lateral spines much longer and more robust, these being almost vestigial in the latter species.

Idionyx optata Selys.

Idionyx optata Selys, 2nd Additions Syn. Cordulines, Bull. Acad. Belg. (2) xlv, p. 196 (1878); Id. Ann. Mus. Civ. Genov. xxx (x), p. 472 (1891); Mart. Cat. Coll. Selys. (Cordulines) p. 80 (1906); Ris. Suppl. Ent. No. 1, pp. 82, 83 (*carinata* nec *optata*) (1912); Fras. Rec. Ind. Mus. Vol. xxxiii, pp. 196, 198, 200, 201 (1926).

Idionyx ornata Fras. (the female of *optata*) Mem. Dept. Agric. India. Vol. vii, No. 7, pp. 66, 67 (1922); Id. Journ. Bom. Nat. Hist. Soc. Vol. xxvii, pp. 688, 689 (1921).

Male.—Abdomen 33-34 mm. Hindwing 33 mm.

Head.—Labium bright ochreous; labrum bright yellow bordered with dark brown; clypeus and front of frons as well as its sides and genae bright yellow; frons above metallic bluish green; vesicle metallic bluish green marked in front with ochreous; occiput black; eyes emerald green during life.

Prothorax dark ochreous; thorax metallic emerald green on dorsum, dark metallic blue on the sides, marked with short bright clear cut humeral stripes of citron yellow extending halfway up the dorsum and laterally, by similarly coloured oblique stripes on the mesepimeron and lower part of metepimeron; beneath yellow, the sclerites dark brown with a bluish reflex. Legs dark reddish brown, tibiae bright ochreous; tibial keels complete on the hinder

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tibiae save at the extreme proximal end, and extending for rather less than the distal half of the anterior pair.

Wings hyaline; pterostigma black, covering to 1½ to 2 cells; anal-loop made up of 9 to 10 cells; hypertrigones all traversed once; 1 cubital nervure in forewings, 1 or 2 in the hind; nodal index.— $\frac{7-14}{9-9}\left|\frac{12-8}{9-9}\right.$, $\frac{7-12}{8-7}\left|\frac{21-6}{7-8}\right.$; membrane brown.

Abdomen black; segments 2 and 3 with the ventral borders yellow, segment 2 with a broad middorsal citron yellow stripe extending its whole length and continued onto segment 3 as a fine middorsal line; the joint between these two segments also yellow. Segment 10 with a very long attenuated middorsal spine directed or sloping somewhat posteriorwards; no ventral tuft of hairs, present as in most other species. Genitalia not differing markedly from that of *I. saffronata*.

Female.—Abdomen 30 mm. Hindwing 30 mm.

Differing in but few respects from the male. The vesicle specialized, a broad short cone, its summit flattened and bearing a transverse sulcus in two directions which cuts it into four small tubercles, yellow the top metallic dark green. Wings deeply tinted with golden yellow at bases as far out as the 2nd or 3rd antenodal nervures and discoidal triangles; anal-loop made up of 12 cells; nodal index.— $\frac{8-12}{10-8}\left|\frac{13-7}{9-10}\right.$; other details of venation similar to the male; abdomen black marked as in the male; vulvar scale not as prominent as in other species, rounded at margin.

Distribution.—Assam. The type is from Cherrapunji and is now in the Selysian collection. Paratypes of both sexes in the British Museum and my own collections.

The male is distinguished at once by the curious shape of its appendages as also by the face entirely yellow, thus differing strikingly from other species. From *I. carinata* Ris., from S. China, to which this species is closely related, the smaller ventral spine on the superior anal appendages and the long fine spine on the sides of the inferior appendage will serve to distinguish it. The female is distinguished from all other species by the flat topped vesicle bearing four small tubercles; in *carinata* the vesicle bears three tubercles, the middle one the longest.

Idionyx intricata Fraser.

Idionyx intricata Fras. Rec. Ind. Mus. Vol. xxviii, pp. 197, 198, 202, 203 (1926).

Male.—Abdomen 28 mm. Hindwing 30 mm.

Head.—Labium yellow; labrum dark ochreous, its borders bronzed brown, clypeus black, the anteclypeus with a small triangular medial yellow spot; frons dark metallic green; vesicle dark metallic bluish green; occiput black; eyes emerald green.

Prothorax blackish brown, yellowish laterally; thorax dark metallic green with a short vestigial humeral citron yellow stripe; laterally an oblique citron yellow stripe on the mesepimeron and another on the lower part of the metepimeron; beneath yellowish, the sclerites blackish brown. Legs blackish brown; tibiae yellow changing to reddish brown at proximal ends; tibial keels closely similar to those of the last species.

Wings hyaline; pterostigma black, covering 2 cells; membrane white at base, brownish posteriorly; anal-loop made up of 8 cells only; hypertrigones of forewings traversed twice, but once only in the hind; nodal index.— $\frac{6-13}{10-10}\left|\frac{13-7}{10-10}\right.$.

Abdomen black; segments 2 and 3 with the ventral borders broadly yellow; segment 2 has also a narrow bilobate middorsal yellow stripe; segment 10 with a prominent triangular middorsal spine but not tapered to a point as in *I. optata*. Genitalia not differing markedly from others of the genus.

Anal appendages black; superiors short and thick, compressed, broad at base and again at apex where the appendage expands into a flattened organ, shaped like a hand shorn of its fingers, save the stumps, of which four may be noted:—a robust spine at the inner angle sloping inwards and down-

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wards, a second adjacent to the last, directed straight back and followed by a third which is a mere kunckle, lastly a fourth at the outer angle, a long robust spine directed straight outwards. The inferior appendage much longer and closely resembling that of *I. optata* but the lateral spines with a greater spread and larger, their inner margins crenulate, whilst the apex is curved strongly and steeply upwards.

Female.—Abdomen 31 mm. Hindwing 35 mm.

Closely similar to the male save for sexual characters and a few other points. Vesicle highly specialized, shaped like the dome of a pagoda, its tapering apex split into two minute points. Wings evenly, diffusely and deeply enfumed especially towards the apices, the bases tinted with golden-yellow as far as the distal ends of discoidal triangles; anal-loop of 10-11 cells; 2 rows of cells between the beginnings of *IA* and *Cuii* in the hindwings; pterostigma covering 2½ to 3 cells, black, longer than in the male; nodal index.— $\frac{8\text{-}14 \mid 14\text{-}8}{10\text{-}10 \mid 9\text{-}11}$.

Abdomen similar to the male but markedly compressed as in the rest of the females of the genus; vulvar scales prominent, projecting in a beak-like manner.

Distribution.—Cherrapunji, Assam. A single pair in my own collection. The male is easily distinguished by the shape of its anal appendages which bear some close resemblance however to *I. optata*. From the latter, the short stouter middorsal spine on segment 10 will at once serve to distinguish it; it is also a much smaller insect. The female is quite easily identified by the unique shape of its vesicle. (In the original description, the two sexes were described apart but subsequently included under one name—thus 'Female unknown', and 'Male unknown', should have been erased but were overlooked when correcting the final proofs.)

Idionyx stevensi Fraser.

Idionyx stevensi Fras. Rec. Ind. Mus. Vol. xxvi, pp. 462, 463 (1924); Id. ibid. Vol. xxviii, pp. 196-198 (1926).

Male.—Abdomen 32 mm. Hindwing 33 mm.

Head.—Labium and labrum bright ochreous; clypeus black; frons and vesicle dark metallic blue; eyes emerald green; occiput black.

Prothorax brownish; thorax metallic bluish green or green, with a short bright citron yellow humeral stripe deficient on the upper half of dorsum, and the usual oblique lateral stripes, one on the mesepimeron, the other on the lower part and border of metepimeron; beneath yellow with a dark oblique metallic green stripe on each of the paired sclerites and a large spot on the unpaired.

Legs blackish brown; the two hinder pairs of tibiae yellow on outer surface, the anterior pair pale brown.

Wings hyaline, the extreme bases only tinted with golden yellow; membrane ashy white; pterostigma black, covering 1½ cells; anal-loop made up of 8 cells; nodal index.— $\frac{7\text{-}13 \mid 13\text{-}7}{11\text{-}9 \mid 9\text{-}11}$.

Abdomen black; segments 2 and 3 yellow along the ventral border; intersegmental joints from 1 to 4 also yellow. Anal appendages black; superiors broad at base, tapering somewhat towards apex which is squared at the end, hollowed out below and presenting on the inner border a short curled digitate obtuse spine and a deep incision just distad of this; the apex bearing a tuft of coarse golden hair. Inferior directed horizontally back, broadly trifid, the apex not upturned save its extreme point; the lateral lobes robust, divaricate, upturned spines. Genitalia very similar to that of *I. saffronata*. Segment 10 of abdomen bearing a prominent triangular spine on its middorsum but not long and tapering as in *I. optata*.

Female.—Abdomen 33 mm. Hindwing 34 mm.

Closely similar to the male, differing only in sexual characters and a few minor points; vesicle simple, rounded as in the male; wings very broadly tinted with golden amber at the bases as far out as the distal ends of

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discoidal triangles; membrane pure white; pterostigma longer and narrower, covering 2 to 2½ cells; anal-loop made up of 9 to 10 cells; nodal index.—

$$\frac{7\text{–}13}{10\text{–}9}\,\Big|\,\frac{12\text{–}8}{9\text{–}10'} \qquad \frac{8\text{–}12}{9\text{–}7}\,\Big|\,\frac{13\text{–}8}{7\text{–}9}.$$

Abdomen compressed markedly as in other species, black, marked as in the male. Vulvar scale similar to that of *I. saffronata*.

Distribution.—North Bengal, especially common in the Darjeeling district. I found it quite common at Mangpu during May; its habits, especially those of the female, were quite similar to those of *I. saffronata* which the female greatly resembles when in the air. The male is easily distinguished by the shape of its superior anal appendages, whilst the female with its broadly tinted wings, simple vesicle and short humeral stripe possesses a complex shared by no other species.

Idionyx nadganiensis Fraser.

Idionyx nadganiensis Fras. Rec. Ind. Mus. Vol. xxvi, pp. 427, 460 (1924); Id. ibid. Vol. xxviii, pp. 197, 198 (1926); Id. ibid. Vol. xxxiii, p. 447 (1931).

Female.—Abdomen 35 mm. Hindwing 35 mm. (Male unknown.)

Head.—Labium bright chrome yellow narrowly bordered with brown; labrum bright citron yellow narrowly bordered with black; clypeus black; frons and vesicle dark metallic blue; occiput black; eyes emerald green during life. Vesicle rounded, simple.

Prothorax brown; thorax brilliant metallic green marked with bright citron yellow.—a narrow clear-cut humeral dorsal stripe on the lower half of thorax, a narrow oblique stripe on the middle of mesepimeron and another on the lower half of metepimeron. Beneath yellow with an oblique stripe of black on the paired sclerites and a transverse one on the unpaired one.

Legs black; tibiae bright yellow on outer surfaces except the anterior pair.

Wings hyaline, very palely enfumed, the extreme bases only tinted with golden-yellow to as far as the cubital nervure or distal end of cubital space; pterostigma black, covering 2½ cells; anal-loop made up of 9 cells; membrane cinereous; nodal index.— $\frac{8\text{–}14}{9\text{–}9}\,\Big|\,\frac{14\text{–}7}{9\text{–}9}$.

Abdomen black, markedly compressed; segments 1 and 2 with the ventral borders yellow and the intersegmental joints between these and segments 3 and 4 narrowly yellow. Vulvar scales hardly visible in profile, extending beyond the apical border of segment 8.

Distribution.—At the top of the Nadgani Ghat, Nilgiri Wynaad, during August. Only two females are known of this rare insect, the type in the British Museum, and one other in my own collection. The specimens I have quoted in the Rec. Ind. Mus., from Coorg and Kanara are doubtfully identified and have the humeral stripe very poorly developed as compared to the type of *I. nadganiensis*.

It is to be distinguished from other species by the simple vesicle coupled with a well-developed humeral stripe. Except for the very restricted tinting of wings at the bases, this species closely resembles the female of *I. stevensi* from Bengal.

Idionyx selysi Fraser.

Idionyx selysi Fras. Rec. Ind. Mus. Vol. xxviii, pp. 197, 198, 201, 202 (1926).
Idionyx yolanda Selys, (Male) 2nd Add. Cordulines, Bull. Acad. Belg. (2) xlv (1878); Fras. Journ. Bom. Nat. Hist. Soc. Vol. xxvii, pp. 689, 690 (1921).

Male.—Abdomen 31 mm. Hindwing 30 mm.

Head.—Labium bright chrome yellow; labrum bright citron yellow narrowly bordered with black; clypeus steely black; frons and vesicle dark metallic blue; occiput black; eyes emerald green during life.

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Prothorax brownish; thorax metallic green marked with bright citron yellow: a short humeral stripe extending up the lower third or slightly more of dorsum of thorax, an oblique rather broad stripe on the middle of mesepimeron and an equally broad stripe on the lower part of metepimeron; beneath yellow, the paired sclerites broadly bordered with bluish metallic stripes outwardly. Legs black, all tibiae bright citron yellow.

Wings hyaline, only a faint tint of yellow at the base of the hindwings; pterostigma black, covering less than 2 cells, short; anal-loop made up of 8 to 9 cells; occasionally 2 cubital nervures in the hindwing; nodal index.— $\frac{6-12}{8-8}\left|\frac{12-6}{9-7}\right.$.

Abdomen black, segments 1 to 3 broadly bright yellow along the ventral borders, and with a fine stripe along the middorsal carina which broadens considerably on segment 2. Segment 10 with a robust middorsal carinal spine which rises steeply up and is variably yellow in part or whole.

Anal appendages black; superiors very long, nearly as long as the last three segments of abdomen, narrow, slightly sinuous and slightly tapered, the extreme apex abruptly turned down at a right angle and pointed; inferior of the same length, very narrow and long as compared to other species except *I. dohrni* and *montana*, the extreme apex tapered to a needle-like point and curled strongly up and over; the usual lateral spines situated very near the apex and very small and inconpsicuous in character. Genitalia very similar to other species of the genus.

Female.—Abdomen 27 mm. Hindwing 30 mm.

Closely resembles the male save for sexual characters; the yellow markings more conspicuous and extensive, the humeral stripe tapering to a point above and nearly extending to antealar sinus; the lateral stripes broader and the underside without its bordering black or with a mere line of this colour. Abdomen with the yellow middorsal stripe on segment 2 very broad especially near the base; this segment remarkably expanded on the dorsum immediately apicad to the jugal suture (There is a suggestion of this in other species but not to the extent seen in *selysi*); segments 7 and 8 with the middorsal carina bright yellow. Vesicle quite simple as in *I. stevensi* or *nadganiensis*, rounded.

Wings only slightly tinted at the base, but little more so than in the male; pterostigma not much longer than in the male; anal-loop with 9 cells; only a single row of cells between the origins of *IA* and *Cuii* in the hindwings; nodal index.— $\frac{6-13}{8-9}\left|\frac{13-6}{8-7}\right.$, $\frac{6-15}{8-10}\left|\frac{14-6}{10-8}\right.$. Vulvar scale similar to that of *I. saffronata*.

Distribution.—The male, described as the male of *I. yolanda* by Selys, from the Karen Hills, Upper Burma, is now in the Selysian collection. One pair, the type and allotype, in the British Museum, and one male and two females in my own collection, are all from Maymyo, Upper Burma, collected by Col. F. Wall in June and July. This species is remarkable for the broad extent of its yellow markings especially the humeral stripe in the female and the abdominal markings. The male is easily distinguished at a glance by the long yellow dorsal spine on segment 10 as well as by the shape of the anal appendages. (These latter are very similar to those of *dohrni* and *montana* but neither of these have the dorsal spine on segment 10.) The female is distinguished by the long clearly defined humeral stripe and dorsal markings on segments 7 and 8.

Explanation of Plate I.

Anal appendages of the males of.—

1. *I. minima* Fras., lateral view.
2. *I. galeata* Fras., lateral view.
3. *I. travancorensis* Fras., lateral view.
4. The same dorsal view.
5. *I. minima* Fras., dorsal view.

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6. *I. saffronata* Fras., dorsal view.
7. *I. burliyarensis* Fras., lateral view.
8. *I. saffronata* Fras., lateral view.
9. *I. unguiculata* Fras., lateral view.

(Camera lucida studies drawn to the same scale.)

Explanation of Plate II.

Anal appendages of the males of.—

1. *I. stevensi* Fras., lateral view.
2. *I. intricata* Fras., lateral view.
3. *I. optata* Selys, lateral view.
4. *I. intricata* Fras., dorsal view.
5. *I. galeata* Fras., dorsal view.
6. *I. optata* Selys, dorsal view.
7. *I. imbricata* Fras., lateral view.
8. *I. corona* Fras., lateral view.
9. *I. selysi* Fras., lateral view.

(Camera lucida studies drawn to the same scale.)

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TIGER SHOOTING IN BURMA.

BY

W. S. THOM.

(*With 2 plates*).

It may be presumptuous on my part to write about tigers when such a very great deal has already been written on this subject by many well-known sportsmen who have accounted for large numbers of these animals in India, where they abound. I trust nevertheless that I may be pardoned for adding my modest quota of observations on Tigers and tiger shooting, as it is to be obtained in Burma. It does not necessarily follow that a man who has shot his 100 or more tigers from a machan, in a beat or, off the back of an elephant knows more about them than the sportsman who like myself has shot a modest 55 of them on foot as well as from a machan at night and who has studied their habits carefully for many years.

I am not prepared to say that tigers are so plentiful in Burma as in India. If, however, the sportsman will take the trouble to look for them in the proper way he will come across them in plenty. They are certainly not so get-at-able here nor are they so easily located as in India.

As trackers and shikaries for marking animals down, the natives of India are I think, perhaps on the whole more persevering workers than are Burmans. *Baksheesh* has, I dare say, a good deal to do with this. Rupees tempt the former more than the latter who are not by any means money grabbers. But when it comes to tracking up bison, rhinoceros, tsaing and elephant, I think the Burman can hold his own with any tracker in the world. Some of the Burmese hunters and trackers employed by me in Upper Burma in the Momeik State of the Ruby Mines and Thayetmyo districts, seldom failed me in following a trail to a successful finish. Among them was Maung Tha Yauk of Kadaing village, Mindon, of Thayetmyo district, to whose peerless skill and fearlessness I owe many a grand day's sport, the memory of which will be with me when my time comes to enter the unknown. All my hunters have joined the vast majority and passed to the bourne of silence from whence none return. If so be that the power is given them, may their spirits be permitted to repass that bourne and to wander afield after the lordly denizens of the jungles they knew so well, when they roamed this earthly world with me.

Owing to the uninhabited state of many parts of the country and the absence of large herds of cattle, tigers in Burma confine their depredations to hamlets situated usually at the foot of ranges of densely wooded hills like the Yomas or in the midst of large

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tracts of virgin forest or low-lying bush jungle. These wooded hills and stretches of grass jungle and forests in Burma were teeming to such an extent with game when I first came to Burma in the eighties that tigers obtained a full meal whenever they required it without coming down to harry the small herds of outlying villages. In India tigers are attracted to the neighbourhood of villages by the large herds of cattle on which they levy a big toll from time to time. The country being on the whole thickly populated, native hunters find it an easy matter to keep an eye on likely patches of jungle and mark down tigers till some 'sahib' willing to pay for the information, comes along. Burmans unfortunately rarely take the trouble to give information when any of their cattle have been killed. They generally prefer to cut up the animal at once and sell or eat the meat. In some districts, tigers play great havoc with buffaloes, bullocks, ponies, pigs, mules and even goats. Tigers are rarely walked up on foot in Burma; whilst organized beats for them with beaters and elephants are seldom undertaken for the simple reason that the jungles in most places are generally too dense and a sufficient number of staunch elephants and beaters are not available. If you are lucky you may have a tiger driven out to you in a beat by Burman beaters who have started originally with the intention of only beating for pig, sambar, barking deer, peafowl and junglefowl. The Burman hunter, owing to inexperience in this kind of work is not particularly keen about beating out a tiger. When it is known that one of these animals is likely to appear in a beat he naturally enough fears having to face the brute should it break back after being wounded.

Then again he is somewhat superstitious. In the jungle a Burman hunter will only refer to a tiger as '*saya*' i.e. the 'master'. He does not refer to the animal as '*kya*' i.e. tiger, but mentions any other name in preference. There are many things one may not do when out shooting in the jungles of Burma with Burman hunters. For instance, it was not considered correct in my time when after big game in the jungles of the Momeik State, Ruby Mines District, for a man to lay himself out at full length on his stomach to drink at a stream when the water could be drunk from the hollow of the hand or out of a bamboo. When eating a cold roast chicken in nature's way in the jungle, it was considered by my hunters unlucky to lay hold of a leg with both hands. It could, however, be held in one hand when eating. If you shot any animal the tip of its tail, or perhaps the tips of its ears or tongue, or sometimes all four portions were tied up to the stem of a bamboo or branch of a tree to propitiate the spirits of the woods after a 'mantrum' of a few words had been mumbled by the person who performed the operation. This was to bring good luck in getting the sportsman a good bull bison, or a good tusker elephant that day, or the next. If these offerings were not made, bad luck might attend the party.

However, unsporting it may seem, the usual method of bagging tigers in Burma is by sitting up in a 'machan' erected in a tree over a kill, i.e., a live or dead bait, such as a cow or a buffalo. Kills or baits are more expensive in Burma than they are in India.

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In Burma in the majority of districts they may cost anything from Rs. 15 to Rs. 30. Besides a Burman is usually a good Buddhist so it is often impossible to obtain a bait unless it is the carcase of some animal that may have been dead some days, or happened to have died, or to have been killed by a tiger just as the sportsman arrived in the vicinity. I invariably undertook to give the owner of the cow the Government reward, viz., Rs. 40 for the tiger should I succeed in shooting it from a 'machan'.

No suitable electric contrivances were available in my day when I shot my tigers. I regret to say I haven't any flashlight photographs of tigers to illustrate this article, such as the really wonderful pictures taken by Messrs. Champion and Peacock and reproduced in the respective books recently published by them. More than half the tigers killed by me were shot on foot.

Some people think that it is not very sporting to shoot a tiger from a 'machan' whilst sitting up over a 'kill' during the night or in the day. This subject has been discussed *ad nauseam* but perhaps I may be pardoned for adding my humble opinion to the rest. It seems to me that shooting a tiger over a 'kill' from a machan in a tree at night is no less sporting than it is to shoot a tiger in safety from the back of an elephant, or one that has been driven up to the guns posted high up in trees in a beat during the way. It has been done and is being done daily at the present time in India but not in Burma. It may be argued again that a tiger when fired at, at night from a machan is more liable to go away wounded than when driven up to the guns posted in trees, by elephants and beaters in broad daylight or when fired at from the back of an elephant. I have never done any shooting from the back of an elephant and never want to do so, knowing nothing about it. I did try it many many years ago but found it so tedious and unsatisfactory that I gave it up. It seems to me nevertheless that driven tigers are just as likely to get away wounded when fired at by the sportsman posted on a tree, or when walked up and fired at from the back of an elephant, as when fired at, approaching, or standing at a 'kill', by a sportsman seated up in a machan at night. An inexperienced sportsman, or an indifferent shot might make a mess of things of course wherever he might be. But it should not be forgotten that a tiger driven to posted guns often travels fairly quickly or slinks away through bushes, when only a fleeting glimpse of him is obtained. He does not therefore present as good a target as would be given to any one posted on a machan at night, who usually nowadays has the advantage of an electric contrivance with which to draw a bead on the animal at a range of generally not more than from about 15 to 20 paces. There are also occasions when tigers have been shot from a machan before the sun has set. Then, last but not least, it should not be forgotten that sitting up over a kill for a tiger is usually the only method available to the sportsman in Burma or to the poor man in India, who cannot arrange for a long line of beaters or elephants. A tiger has, I suppose, a better chance of escaping with his life when fired at by a sportsman, seated, shall we say on the pad of a moving elephant, than he

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has perhaps when he is driven towards a sportsman seated on a machan up a tree, or when fired at from a machan at night over a 'kill'. I dare say just as many tigers have been fired at, wounded and lost by sportsmen shooting off the back of an elephant, as from a tree in a beat, or from a machan at night. Ultimately, one is led back to the question as to which method is the most humane and sporting. That is not an easy question to answer, as every one has his own opinions on the subject.

I cannot agree that sitting up for a tiger on a machan at night with an electric contrivance is unsportsmanlike. I have never done so myself because I never had an opportunity of using an electric contrivance, but I see no more harm in doing that than in shooting at a tiger from a 'machan' with a good moon in one's favour. With an up-to-date electric contrivance a tiger has less chance of getting away badly wounded. In case of a tiger being fired at and wounded, the correct and humane thing to do is of course to follow the beast and finish it off. If possible, this should be done not only to prevent the animal dying a lingering death but because a partially disabled tiger with a leg or shoulder shattered might become a maneater through not being able to pull down game or village cattle, as before. It is very easy to point out one's duty in this respect and say that wounded tigers should always be followed up and finished. It is all very well when one can do it riding on the back of an elephant, or can so manipulate a herd of buffaloes as to keep them between one and the tiger when he charges. It is the devil when one has neither one nor the other at one's disposal and one is finally egged on to proceed on foot by the thought that at any moment the animal is sure to be found lying stretched out dead. Everything depends upon where the tiger has been hit. If the bullet has been placed too far back and only gone through his intestines, like bison, a tiger will often survive several days and will be a devil incarnate before succumbing to a body shot. It should be borne in mind that a tiger when mortally wounded rarely utters a sound, except perhaps to emit a faint groan, or grunt, but, an animal that has had, say, a leg broken, or a hit on some other non-vulnerable spot, where the bones may have been badly damaged, invariably utters a succession of short angry grunting snarls or roars. There is no mistaking the noises made by an infuriated, wounded charging tiger that means business, and intends getting home on to some one. Once heard, they will never be forgotten. Hearing those awful hoarse, coughing roars, one feels as if one's bowels, in Biblical terms, had turned to water.

The great thing to remember in tiger shooting is that the bullet should be a big and heavy one with a fairly large charge of powder behind it. It is all very well shooting at a tiger from a machan with a small bore rifle or a 12-bore shot gun, burning say 3½ drachms of powder and taking a spherical bullet, when one is 15 or 20 feet off the ground. One may be lucky with one's first shot from the tree, and kill the beast, but unless equally lucky one would be courting almost certain death to fire at the animal when on foot on the ground. 3½ or even 4½ drs. of black powder or its equivalent charge in smokeless or cordite, hardly gives suffi-

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cient penetration. Moreover the feeling of confidence in being up a tree makes one hold much straighter than one would ordinarily do facing the tiger on foot. An experienced European shikari, who it seems to me was lucky to escape death, followed up and faced a wounded tiger armed only with a ·280 Ross rifle.

There was nothing in the old days to beat the good old magnum ·577 black powder rifle which burnt a charge of about 7 drs. of black powder. The heavy, soft lead bullet of this rifle, when it acted effectively, usually mushroomed and, after passing through the body and doing a lot of damage in its course, was held up from passing out by the skin on the outer side. Of course there would be occasions also when the bullet passed clean through the animal's body after mushrooming and doing much damage.

Some men swear by small bore high velocity magazine rifles such as a ·318, ·280, ·303, ·276, ·240 or ·256 because they are light and easy to carry whilst the trajectory is also low. Bell, the author of 'The wanderings of an elephant hunter', shot all his elephants and lions in Africa with one or other of the small bore-rifles mentioned above; whereas Sutherland, who shot over 500 elephants in Africa used a double ·577 cordite rifle. A rifle that is suitable for dispatching an elephant, rhinoceros, bison or buffalo is also required for killing a tiger. A high velocity ·500, ·475, ·465, ·470 or ·450 bore cordite rifle burning between 70 or 80 grains of cordite would be quite suitable to use on a tiger whether on foot, on the back of an elephant, or on a machan. I personally would just as soon use a Westley Richard's double ·12 bore magnum Explora cordite gun at close quarters on a charging tiger. A double barrelled ·577 hammerless ejector cordite rifle burning a 100 grains of cordite might be of use in the hands of some sportsmen for tiger, but I should relegate it to its proper place, namely for use say, on a solitary tusker elephant, bull gaur, rhinoceros, buffalo, or tsaing, when a picked shot can be taken or when one of these animals was charging. But it is a deuce of a weapon to have to carry any distance when the thermometer registers 95 or 100 degrees, although in the old days I used to think nothing of carrying a heavy black powder ·8 bore 'Paradox' burning 10 drs. many a mile over steep and broken ground. The ·577 if held straight will usually knock out most animals although I have had it fail me on two separate occasions on solitary bull bison.

Can it be said by any one that there is not fascination or excitement enough in sitting up in the jungle, alone with nature and a full moon, far away from any village or human being waiting for a tiger to put in an appearance? Can any one swear that his pulse and heart does not beat faster or that his senses are not stretched to their utmost tension on hearing the sounds of a breaking twig accompanied by the subdued sniffs which are sometimes emitted by a tiger as he cautiously pushes his way up to the kill? If he cannot experience all these feelings then, all I can say is that he need not imagine he is a sportsman in the sense that I mean. I do not believe in the calm phlegmatic sportsman devoid of all nerves or any sense of excitement. There are quite a number of men of this description nevertheless, who do not experience any

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sensation in the jungle. I have known others who having sat up for a tiger have not had sufficient guts to fire at the animal when it did put in an appearance, or, who were so shaken that they made the machan creak so badly as to cause the tiger to take alarm and make off. Captain F. C. Selous, the famous African hunter, and I believe the original of Rider Haggard's *Allan Quatermain*, who was shot dead at the head of his company in East Africa during the war when he was over 60, although of a quiet undemonstrative disposition was yet possessed of any amount of quiet fiery nervous energy and pluck. He was known to be one of the keenest sighted and quickest observers of his time in the jungle. There is no doubt that a long sojourn in the jungle when one is continually tracking up and coming in contact with large wild dangerous animals sharpens a man's wits and senses to a very great extent. I trust I may be pardoned for remarking that I found from a lengthy experience in the jungles of Burma that all my senses of sight, hearing, smell, taste and touch, soon became very highly developed. I could also walk through the jungle as lightly as a cat and still be able to see everything ahead and all around me without treading on a leaf or snapping a twig. Then again my sense of direction also became almost as good as some of my trackers.

Considering Selous had done so much big game shooting in other countries, it had always appeared strange to me why this noted sportsman never came out to India or Burma to shoot tigers or the lordly gaur, the largest of all the bovines in the world, not to speak of the tsaing or banting (*Bibos banteng birmanicus*) and the brow-antlered deer (*Rucervus thamin*) none of which he had ever seen, and which are only to be found in the East. It was only when I was last at home in Scotland in 1897 after being introduced to him at Perth by Sir Scott Monterief after a lecture given by Selous that I learnt his real reasons for not visiting India or Burma to shoot. During the course of a long conversation I had with him on shikar he informed me that the reasons which had deterred him from visiting India or Burma were that he was married for one thing, and was moreover growing old, whilst he was not a rich man. He told me then also that he was collecting specimens for museums and wealthy men owning collections such as the Rothschilds and others.

Among several of the tigers bagged by me in Upper Burma was one I accounted for at a place called Nanyaseik in the Myitkyina District, a place once famous for its big game, now somewhat thinned out by the Kachin, Burman, Shan and Gurkha hunters.

After a hard morning's work with bison—there was a big bull in a herd which I had to my disgust missed most disgracefully—, I was just stepping out of my bath preparatory to having breakfast, when the Gurkha caretaker of the Nanyaseik Public Works Department bungalow came galloping along on his pony up to my camp and after dismounting shouted out to me in a great state of excitement that a tiger had killed a cow that morning close to the village and was still feeding upon the carcase when he left Nanyaseik. It was then about 10-30 a.m. The poor man had come along at

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such a pace that he had fallen off *en route* and barked himself badly in two or three places. As I was on my way to Nanyaseik to inspect a Police outpost there, the 'Khubber' suited me down to the ground. On my arrival at the village at about 2 p.m. I learnt that no one knew anything about the animal or kill but that a Shan on his way home early that morning, when within about five or six hundred yards of Nanyaseik village had seen the tiger which had sprung backwards and forwards across the road in front of him several times and had then disappeared. The Shan it seems thinking the animal meant mischief had drawn his long fighting 'dah' out of its sheath to defend himself, and had then bolted for the village after uttering a shout or two to frighten it away. This had the desired effect for he did not see it again. I now learnt also that an old emaciated cow belonging to no one which used to wander round the village had at last dropped down from sheer exhaustion and old age. It was lying helpless in a small clump of plantain trees situated within about 40 yards of the village and about three paces from the high road along which the Shan had been travelling when he encountered the tiger. The whole affair had been grossly exaggerated and I saw at once what had really happened. The tiger had evidently been on his way to stalk and kill the cow when the meeting with the Shan disturbed him and put an end to his plans. The encounter had evidently displeased the tiger who had shown his displeasure by acting as he had done. The villagers and the durwan or caretaker of the bungalow on hearing the Shan's story had at once taken it for granted that a cow had been killed by the tiger, and, although it was broad daylight when the affair took place, and there was a gun in the village belonging to the headman, no one thought for a moment of going out to see whether the cow had or had not been killed. I settled the matter when my pack mules turned up with my kit and guns by going and seeing for myself. It is marvellous what confidence is inspired in these villagers by the presence of a white man. Although they kept at a respectable distance behind me, some 20 villagers in all accompanied me to the scene of the supposed kill. Here I found the cow lying down untouched, and of course there were no signs of the tiger. The unfortunate animal it seems from enquiries made by me on the spot, had, for the past two days, been left lying helpless where it had fallen, in the blazing sun, without either food or water. It is against the Buddhist creed of course to put an animal out of its misery by killing it, or indeed to take any life at all except in self-defence, so I killed the poor brute myself as mercifully as possible by shooting it and then had it disembowelled and its throat cut. This sounds rather gruesome I will admit, but it was necessary to have the scent of fresh meat and blood wafted abroad north, south, east and west so as to attract the tiger as soon as possible as I had no time to spare.

As it was full moon that night, and there was some possibility of the tiger turning up, I decided to sit up in a machan over the carcase of the cow as soon as the villagers erected one for me. A small rickety platform of bamboos was accordingly erected by

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the villagers at a height of only about 10 feet from the ground in the centre of three or four plantain trees which stood within about 15 feet of the spot where the carcase lay. My instructions regarding the erection of a proper machan had not been followed much to my disgust. A Burman of course will sit on the branch of a tree and wait all night for a shot at anything without feeling fatigued. The Shans in the locality did not apparently know anything about the erection of a 'machan' and did not understand what I really wanted, so I had to sit on a single platform. I went back however to the village I was camping at for a cane 'morah' or stool and laid a rug over this. That made matters a little easier for me, but of course I was by no means as comfortable as I might have been had two platforms been erected. I usually made a point of having a machan made of the green boughs of trees, as if bamboos are used they invariably creak when any movement is made on the machan, which would be sure to scare away the tiger or keep it from coming up to the kill. I also preferred a double platform, one above the other as it were, about 2′ 6″ apart. Each platform would also be 7′ long by 4′ wide. This enabled me to sit on the upper platform and rest my feet on the lower one or I could lie down and rest on the upper one when I wanted to, and stand on the lower one when necessary, so as to enable me to turn round and shoot at the tiger in an erect position from any direction over the parapet of leaves, usually erected round the sides, front and back of the machan to shield the hunter from being seen. I also invariably wore rubber shoes and had a dhurrie or rug laid on each platform to deaden any sound I might make when I moved about on the machan. I found a rope ladder very useful for getting into the machan from the ground. I never as a rule sat on a machan at a lower height from the ground than 15 or 20 feet. That is really the minimum height one should be installed from the ground. Charpoys and ready-made machans can also be obtained and put up in a very short time. A good double platform machan takes several hours to make properly and at least 8 or 10 men are required to carry out the work. I might mention here for beginners that villagers who have been deputed to erect a machan over a kill should see that all the material is cut at some spot a good distance away from the tree on which the machan is to be built. The work should be done with as little noise as possible so as not to disturb the tiger should it be lying up, as they often do, near the kill. Then again, if the erection of the 'machan' has for some reason been delayed till a later hour, say sunset, the villagers, after they have completed the erection of the 'machan', should return to the village talking, laughing and singing, so that the tiger, should he be in the vicinity, may hear them, and imagining that all was well turn up at the kill at an earlier hour than he would ordinarily have done.

All the split bamboo shavings or withes used for securing the machan, the cut boughs and branches and other odds and ends, left lying about on the ground near the 'machan', or near the kill, should be collected and hidden or taken away altogether a good distance from the machan. If this is not done a knowing tiger

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might after reaching the kill become suspicious on seeing all this rubbish lying about, rubbish that was not there when he was last at the kill, and clear off at once in consequence. I have however shot several tigers that have come up to the kill in broad daylight before 5 p.m. In fact some have started feeding at once without taking any notice whatsoever of the rubbish heaps that had been left lying on the ground in the vicinity of the 'kill' or the machan. Tigers do not as a rule like feeding on a kill that has been dragged into an open space near a suitable tree for the erection of a machan. I always made a point of having two large stout stakes driven into the ground for several feet and secured one at the neck and the other at the hind quarters of the kill. It is a good thing to take into the machan a small haversack full of stones with which to bombard the body of a tiger that you may have fired at and that may be lying within sight of the machan in order to see whether it has any life left in it. Some people say you must not smoke whilst seated on a machan waiting for a tiger to put in an appearance in case the animal should scent the tobacco smoke and not turn up. I doubt whether there is much in this. If the tiger can scent the tobacco smoke he can also scent the sportsman. It is much better sitting up alone for a tiger. I personally prefer being alone. My experiences of sitting up with Burmans is that they either go to sleep and snore, develop a cough, or want to clear their throats, which, as can be understood, does not facilitate the arrival of the tiger at the kill. It is better to wear a pair of long lose dark coloured flannel trousers, stuffed for choice at the bottom, into long soft leather mosquito boots with crepe rubber soles. The lower platform of the machan should have very strong stout branches well-laced closely together in such a way as to shut out any possibility of the tiger being able to force his way through it should he scramble up the tree in an attempt to get at and claw the sportsman off his perch, a thing which tigers are capable of doing and which has been done in India on several occasions. One has only to watch a cat scramble up a tree to a considerable height when frightened or chased by dogs to understand this and after all a tiger is nothing more than a large cat although a very dangerous one. I could go on *ad infinitum* and mention other tips useful to the beginner in the jungle, only I should be afraid that my readers would be bored stiff if they have not already reached that stage. I shall risk it however, and only refer to one more tip which will certainly be the last. Sometimes one is belated in the jungle through having covered more country than one intended doing and finds on one's return in failing light that the fore-sight cannot be seen very clearly it being only, shall we say, a fine black bead. One then meets a tiger, which, under these conditions, if one is wise, is not fired at. Messrs. Westley Richards the well-known gun and rifle makers invented a black metal sheath with a white circular porcelain or enamel bead fore-sight which can be slipped on at once and is easily seen in fading light when the ordinary black bead would be more or less invisible. If I mistake not, there is a set of four of these slip-on night sights made, graduated from the size of a large pinhead

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to one the size of a pea. They cost about half a crown the set. Some makers call them gloaming enamel fore-sights. Messrs. Manton & Co., Calcutta, I know keeps them in stock. For a young man with good eye-sight an ordinary fine black bead fore-sight is good enough during the day except in failing light, when one of the above mentioned slip-on sights would be required. For a sportsman like myself who is nearing his seventies, a platina, platinum or German silver bead fore-sight (these three sights are pretty nearly all alike in appearance) would be preferable. It is more easily seen than a black bead fore-sight especially when one is using shooting spectacles. Ivory-tipped fore-sights wear more rapidly, and are more easily broken. As a matter of fact the sportsman should have a spare fore-sight for each rifle in case of accidents and it should be possible to screw these on without much difficulty.

I must apologize for this lengthy digression. The majority of the suggestions made by me are all well known to experienced sportsmen and are probably considerably out of date in the opinion of some. However, they may be of some use to the sportsman who has not accounted for a tiger and is keen on doing so.

To come back to my tiger, taking a revolver and my 12-bore 'Cosmos' ball and shot gun built by Cogswell & Harrison to burn only 4½ drs. of black powder and throwing a heavy conical bullet, the only suitable weapon I had with me at the time, other than a heavy 8-bore rifle I entered the machan alone at 6 p.m. At 7-30 p.m. the moon having risen well above the tree tops in a cloudless sky everything was brilliantly illuminated. Drops of shining moisture, the result of a heavy dew were now falling from all the bushes and trees around me with a steady patter. Suddenly from a neighbouring hillside away in front of me about a mile off where there was some very heavy cover I heard the roar of a tiger followed by others at intervals. These drew nearer and nearer, and then ceased altogether as the animal approached the village. She, for it turned out to be a tigress, was noted for the noise she made when she began her nocturnal prowls. I was only hoping fervently that she would come near enough to the kill to obtain a whiff of it. She turned up as a matter of fact much sooner than I expected taking me completely by surprise. About 8 p.m. while I was leaning forward staring vacantly at the kill, and dreaming of the past, my gun lying across my knees, I was thunderstruck at suddenly seeing on the other side of the kill, within a foot or two of it, a shadow, a something that was not there before, which vanished again as noiselessly as it had appeared. It was the tigress which had come and gone without so much as deigning to even sniff or look at the carcase, far less give me an opportunity of levelling my gun at her. I should have said that before disappearing she lifted her head and looked at me full in the face for a second. Whether she saw me or not or suspected something I am unable to say; at any rate she did not appear to be particularly hungry. It was marvellous how the colours of her coat blended with her surroundings and made her partially invisible when standing in front of me with a full moon overhead. Think-

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ing that she might perhaps turn up again I waited for another hour. She did not put in an appearance however, so I descended from my perch, went to the village and to bed. My Madrassi boy on waking me in the morning with my tea and toast greeted me with the comforting news that the tiger had 'done finished' eating the cow, his way of putting it, that the tiger had had a meal at the carcase during the night. I was in the 'machan' again that evening alone at 6 p.m. determined not to be caught napping again. As a matter of fact 4-30 or 5 p.m. would be a better hour to get into the 'machan' than 6 p.m. as there is no knowing when the tiger may turn up. If the kill is far from any village it may turn up early, if it is close to a village and it is a sophisticated animal, it will not come before 8 or even 9 p.m. I have shot several tigers that turned up at the kill at 5 p.m. but these were kills situated several miles from any village. At 6-30 p.m. some way off from the edge of a neighbouring clearing I heard a jungle fowl get up with a cackle and fly away screaming. Some monkeys also which had been feeding close by kept up an incessant chatter till darkness set in when all sounds ceased. These were distinct signs that the tiger was afoot, for I knew that no villagers were about here. Although no roars were uttered this time she made no secret about her approach, for, at about 7-30 p.m. after the moon had been up some time, I heard her moving stealthily along the undergrowth towards the carcase. She did not hesitate once but came straight on being evidently quite unsuspicious of any danger. On reaching the body of the cow she sniffed at it once or twice and then suddenly throwing up her head directed a piercing glance at the 'machan'. Her yellow eyes appeared to be looking straight into mine. Appearing satisfied with her inspection she lay down on all fours and after making one or two determined efforts to remove the carcase which I omitted to say had been very carefully staked down, gave it up as useless, and then set to work and buried her teeth in the meat. I was determined to let her have plenty of time so waited fully five minutes during which she raised her head a number of times and listening to every sound that came from the village.

I should have stated that my gun was fitted with a large white flat circular porcelain night-sight about the size of a pea. This night-sight could be folded down flush with the rib of the gun when it was not in use, i.e., during the day, when the other bead fore-sight for use in daylight was required. I found this night fore-sight showed up very well when I had the moon at my back and I always made it a point when I did sit up at night in a machan to see that the machan was constructed in such a way that I could face the kill and the tiger with the moon at my back, for with the moon's rays shining in one's face it was almost impossible to see the night sight at all. Confound these digressions and old fashioned ideas and explanations I hear some one say. I trust nevertheless that I shall be forgiven for making them.

Finally I aimed for a point between her neck and shoulders and fired. A series of the most appalling snarls and roars followed

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my shot as she dived out of sight with a crash into the undergrowth some five or six paces from the kill. Here she rolled about roaring and snarling in a manner exceedingly trying to the nerves. From the sounds emitted between her growls she seemed to be alternately swallowing and ejecting mouthfuls of blood. As the undergrowth was about 5 or 6 feet in height here, I was unable to see any portion of her or else I would have at once put her out of her misery by firing again. It became apparent to me that she was fast getting into a comatose, and therefore harmless state. She had by now begun to breathe stertorously, the loud snoring noise being audible at a distance of at least 150 yards. I descended from my perch and got out on to the road where I joined the villagers who had turned up *en masse* armed with spears and 'dahs'. I was exceedingly puzzled to know where I had hit the animal and assumed that the bullet must have got her about the head somewhere and had then passed down her throat. Directing the villagers to make a big fire at a safe distance and let me know when all sounds ceased I went back to the bungalow and sat down to dinner. I had not been absent more than 25 minutes when my ears were greeted by a series of yells and cheers from the direction of the kill. Guessing what had happened I jumped up from the table sending my pudding of plantain fritters flying, seized my gun and was out of the bungalow and at the scene of the kill in a trice. As soon as they had heard the tiger's groans cease the whole village to the number of 20 or 30 hard turned out in a body during my absence with bamboo torches and lanterns. In spite of my warnings, they literally cut a passage through the undergrowth to the spot where the tigress, fortunately for them, lay dead. I found them all congregated round the animal, busily engaged jabbering away and measuring the beast. My bullet had caught her below the right eye, crashed straight through the base of the skull fracturing it slightly without damaging the brain, and then continuing its course through her mouth and throat lodged eventually in her hind quarters near the root of the tail. She had I suppose really died of suffocation, loss of blood and shock to the brain. The tape showed her to be only 8½ feet in length.

The circumstances connected with the shooting and bagging of a large tiger which measured 10 feet 4 inches, is the record for Burma, which was wounded and then followed up on foot accompanied by a few Military Police Gurkhas and Burmans, bring back very unpleasant recollections. They can never be erased from my memory for they resulted in the mauling and subsequent death of one of the Gurkhas with me at the time. I was then encamped at Sinbo, a village situated on the banks of the Irrawaddy in the district of Myitkyina. Information reached me that a tiger had killed a cow during the small hours of the morning at P. a village on the banks of the Irrawaddy about one and a half miles above Sinbo. Directing my clerk to send out word at once to the headman of P. to see that the carcase of the cow was not broken up and distributed amongst the villagers, I hurried through with breakfast and ordering only my pony to be saddled galloped out

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to P. with the object of superintending the erection of a machan with the view to sitting up for the tiger the same night. I found the cow lying in the jungle with its neck broken. It was some 20 to 30 paces from the cart track leading into the village which was distant from the scene about 150 yards. This tiger was evidently a noted cattle lifter for he had often been heard of in these parts and though he committed his last offence in such close proximity to the village no one heard a sound. He had evidently helped himself considerably in his first meal. Some big junks of meat probably 15 to 20 lbs. had disappeared from the cow's hind quarters. After turning out the villagers I had the carcase dragged out on to the road where, to begin with, I had it securely staked down to the ground. Most tigers dislike feeding in the open, and invariably move the carcase if they can, out of sight, into cover. As there was not to be a vestige of a moon during the night, and torches had not yet been invented, I was obliged to have the platform rigged up as low as possible to enable me to see anything at all. Owing to the absence of trees in the vicinity of the road it was necessary to have three poles inserted in the ground as supports in the shape of a triangle amongst the bushes by the side of the road. Upon these at a height of about eight feet a seat or double platform (such as has already been described by me in this article), large enough for one person only, was constructed. It faced the road and kill which lay in the centre of the road way. After seeing the machan completed a matter of about three hours' hard work I cantered back to Sinbo and after bathing, changing, and having some tea, galloped back to P. and entered the machan alone at 6 p.m. I had not been seated in the machan ten minutes before I heard the tiger 'titting' from a neighbouring plantain grove about 150 yards or so from my machan. Carts and buffaloes were still passing at the time along the road on their way back to the village from work. This tiger which had evidently never been fired at before was a noted cattle lifter. He just used to walk up in broad daylight, help himself to a good fat heifer and then walk off again. He was evidently a greedy animal and was in a devil of a hurry to get back to his 'kill', but he did not like hearing all this traffic viz., the creaking carts and the loud knocking sounds emitted by the hollow wooden clappers or bells worn round the necks of the buffaloes, also the noise of the commands which were issued by the cartmen to their bullocks. The tiger knew perfectly well that these noises were being made near his kill and he did not like it at all, so gave vent to his anxiety, impatience, suspicion and perhaps annoyance, by uttering there 'titting' calls. These calls or 'tits', which is a Burmese expression, are almost exact imitations of the bells of a sambar that has been disturbed, except that they are sharper and shorter.

I trust I may be pardoned for referring to this subject again and that the Editors of the *Journal* as well as the readers of this article will forgive me for being so égotistical as to lay claim to being, I believe, the first European sportsman to bring forward a suggestion that the true reason for a tiger making these 'titting'

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calls was that it does so on being disturbed suddenly by human agency. To begin with it is not a call from one tiger to another, or in other words a mate call, for in this case I am quite convinced there was no mate in the vicinity. I have moreover heard these calls, uttered by tigers on no less than twelve different occasions in Burma, when the animals that made them, had either been shot at and missed, or had been disturbed suddenly when at the kill or in some other way by human agency. On each, and every occasion, there was certainly no mate. An article by me on this subject entitled 'Notes on tigers and their calls', will be found on page 548, vol. xxix, No. 2, dated 25th August 1923 of the Bombay Natural History Society's *Journal* where my views on the subject are clearly stated. On pages 462 and 463, vol. xxx, No. 2 of the same *journal*, dated 25th January 1925 will also be found an article by Major James on the same subject. Mr. Dunbar Brander also discusses the matter on page 905, vol. xxx, No. 4, dated 15th December 1925. He states however that the origin of the call has to do with a mate. I am afraid I cannot agree as to the supposition that the sambar is lured to his destruction by the tiger's mimic bell or 'tit'. Why should a tiger, monarch of all he surveys in the jungle, with eye-sight, hearing, strength, agility and speed beyond compare, and who has little or no difficulty in procuring a meal at any time have recourse to such deception. Mr. Peacock calls a tiger's 'tits' a note of surprise. He might add doubt, alarm, suspicion and apprehension, but I suppose these after all amount to the same thing.

The Editors of the Bombay Natural History Society's *Journal* in summing up the matter on tigers' 'titting' were, I flatter myself inclined to take my view of the matter, namely, that these 'titting' calls are made by the animal when it is in doubt, or has been thoroughly alarmed by human agency. Even if two tigers, which are mates had become separated through having been disturbed by human agency and were 'titting' together at intervals, it seems to me quite clear that they were 'titting' not necessarily to let each other know the other's whereabouts, a thing surely that any tiger could easily ascertain in no time by instinct alone, as indeed could most wild animals, but because they had both been alarmed and were on the *qui vive* and were perplexed and upset, or suspicious regarding the situation. I heard a tiger calling or 'titting' incessantly round our camp on the Lemro River in Arakan one night, after Walker, D. C. Forests, had shot a tiger over a kill which I had tied up for him about a mile from camp. The tiger was shot at about 8 p.m. and the 'titting', whether made by the dead animal's mate or by another animal, it is impossible to say, began in the vicinity of our camp the same night at about 10 p.m. We left the carcase of the tiger lying on the ground, after the skin had been removed, about 150 yards from the bamboo huts we were camping in. There was no doubt that this 'titting' tiger was alarmed not only by our camp being where it was but also probably because of the smell of the carcase of the dead tiger. Our camp had been constructed on both banks of the Lemro River in such a way as to block (not intentionally) the passage of any

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animal coming up or going down stream, along the banks of which a regular cat walk for tigers existed. The animals could not make a detour at this particular spot as the hills were much too precipitous on both sides. Even if the 'titting' animal was attempting to call up its dead mate it was a note indicative of suspicion and alarm. Shortly after my article in the Bombay Natural History Society's *Journal* appeared putting forward my views as to the reason for tigers making these 'titting' calls, a gentleman writing anonymously from Mandalay, who had seen a similar article of mine in the *Rangoon Gazette* prior to the one published in the Society's *Journal* on the subject of tigers' 'titting', which by the way is a much nicer word than 'pooking', wrote as follows to the *Rangoon Gazette*. 'For the information of your correspondent W. S. T. (which are my initials) whose interesting article "A few notes on Tigers and their calls" appeared in your paper dated the 12th July, 1923, the well-known Burmese proverb "Lu-kyauk-yin-hit-the,-kya-kyauk-yin-tit-the," will tell W. S. T. or any one who is in doubt as to the cause of tigers "tittings", that tigers "tit" only when they are alarmed or frightened.' The literal translation of the proverb means 'when a man is suddenly startled he makes an exclamation like "hit-the" and when a tiger is startled suddenly he "tits".' I was not aware till the Mandalay note (which I subsequently learned was written by the late Lt.-Col. H. H. Harrington, 62nd and 92nd Punjabis, a well-known ornithologist and an authority on the birds of Burma) appeared in the *Rangoon Gazette*, that any such Burmese proverb existed. This would therefore bear out my contention that a tiger only 'tits' when alarmed or suspicious and that it has nothing whatsoever to do with a mate call.

Although I trust I will not be accused of appearing to be tedious on this subject I will drop it for ever after giving one final instance of a tiger 'titting' on being suddenly alarmed.

I was sitting on the banks of the Lemro River in Arakan one night at about 9-30 p.m. about 100 yards or so above our camp after dinner, smoking and talking with Walker of the Forests. A tiger, which, judging by its tracks, had been walking down stream along its usual beat on the side on which our camp stood, there being no villages for miles around, almost walked into Walker and myself before noticing us. On suddenly discovering our presence from a distance of only about six yards, a bunch of rocks having hidden us from view, it dashed away up the steep bank above us sending a stream of gravel and small stones hurtling down upon us. Then, from the jungle above us, it made the welkin ring at intervals, with its short, sharp, nervous bells, or 'tits' of alarm. I am afraid however I have made a very long digression so let me get back to the tiger I was sitting up for.

All noises gradually subsided as the light faded and the stars came out one by one. I was attracted at first by hearing some harsh grating, purring sounds from the jungle behind. They appeared to be drawing nearer and yet nearer. I listened, my heart pounding like a sledge hammer, and peered down steadfastly

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at the kill which I could just see dimly lying out along the bare portion of the road not more than 12 to 13 paces from where I was seated. At first I thought they were leopards but they turned out to be hungry jungle cats which, having scented the dead cow from afar, were dying to get within eating distance, but dared not knowing full well that it was the kill of the dreaded midnight prowler and that if he found them there it would be all up with them. These animals were moving fussily round the kill for a long time, making a great show of coming right up to it for a mouthful. But they could never screw up enough courage to do so. Suddenly they scurried away in a terrible hurry and disappeared for good. I was certain now that they had winded the tiger and that the latter could not be far off. Getting my gun noiselessly forward into position, I leant over, and remaining motionless, kept my eyes fixed on the carcase in front of me. Its outline could now be seen with difficulty. It was an exciting moment, as any one knows who has sat up on a dark night and within springing distance, waiting for a tiger to put in an appearance. In order to be able to see the muzzle of my gun more easily when taking aim I had tied a small triangular-shaped piece of white cloth, on to the muzzle about half an inch above the fore-sight. The small white procelain night sight being quite invisible without a moon, this served the purpose fairly well, although I could only just see it when the gun was at my shoulder. It was now 7 p.m. and quite dark. I could hardly see the carcase as it lay at full length along the bare patch of pathway which showed up along the centre of the cart track. Suddenly without any preliminary warning, the kill in front of me, at which I had been steadfastly peering, until my eyes felt like starting out of my head, was blotted out of my view and I knew the tiger had caused the transformation and was now standing between me and it like a huge black shadow. There was a death-like stillness for about three or four seconds and then a loud sniff followed by a crunch and the breaking of sinews and bones as the tiger seized the cow by the neck and pulled and tugged for all he was worth to try and remove it. The stout pins and rope however withstood all his mighty efforts although they were continued for the space of half a minute. In the position he was then in I could not see him clearly enough to risk a shot. Moreover he appeared to be all over the place. I preferred to risk a shot only when he was lying down on all fours feeding on the carcase. Just then a buffalo, which had evidently got scent of the tiger or the dead cow, broke loose from the village and came careering along the road towards the carcase. This was evidently too much for the tiger for all sounds from the 'kill' ceased immediately, and he disappeared as quietly as he had come. The buffalo swerved off the road on seeing the body of the cow and then, breaking past the platform on which I was seated, nearly carrying me and it away with him in his mad rush, disappeared into the jungle with a terrific clatter. I was terribly disappointed, for of course I never expected to see the tiger again. All became still once more and the minutes went past like hours. I was determined to give the tiger two full hours' grace before descending and

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giving it up as a bad job. But the animal turned up sooner than I expected, within an hour in fact, when the kill received the same violent treatment as on the first occasion. This time, however, having failed in his efforts to remove it, he began feeding on the hind quarters, lying out at full length along the road broadside on to me in the exact position I had hoped to see him occupy. I waited for some seconds which appeared to me like hours, till his suspicions had been thoroughly lulled and his teeth were well home into the meat. Hardly daring to move a muscle for fear of alarming him, yet, raising the end of the gun over the parapet of leaves in front of me and taking a long, careful aim for what I took to be the tiger's shoulder, I pulled the trigger. A succession of short, sharp, angry grunts and roars split the air as the animal, evidently hard hit, dashed headlong over the carcase to fight an imaginary foe. I was unable to see from the cloud of smoke which hung between us and hid everything from view, what the brute was really doing. During the few seconds he roared, snarled, and fought over the body of the cow, it was evident to me from the diabolical sounds emitted that he had been badly wounded. Presently all sounds ceased and then a few feet away beyond the 'kill' in front of me, I heard the rattle of some dry bean pods on some small dead bushes, and then all was quiet. I waited for fully twenty minutes before moving or uttering a sound in case the tiger should be lying up close by. Having meanwhile loaded both chambers of my gun with cartridges filled with slugs, drawing a whistle from my pocket I blew several shrill calls to bring up my men. They were not long in putting in an appearance with two hurricane lanterns. I shouted to them when they were about 80 yards off, to hold hard and not to be in too great a hurry. After we had shouted and yelled ourselves hoarse for a few minutes and conversed with one another at a respectable distance, the men came along the road holding their lanterns high above their heads, whilst I stood and covered their approach with my gun. As they came up I descended from the machan, and with them carefully examined the 'kill' and the surrounding ground for any marks of a bullet-hole. After a lengthy inspection, we failed to find any bullet-hole but we noticed that the tiger, after being hit, in his rage and agony had sprung upon the cow's head and worried it, pulling off a horn with its teeth during the mad struggle which followed my shot. There was only a splash of blood on the carcase of the cow which, according to one of my men, had fallen from the tiger's mouth. 'This is a good sign', another man said. 'he has been shot through the lungs and we will find him in the morning, close by, dead.' I had considerable doubt about this in my own mind at the time. A tiger which has been shot through the heart, liver or lungs, that is to say, which has received a mortal body wound, seldom utters any sound at all, or only emits an almost inaudible grunt as he makes off. But a tiger that has had a shoulder or a leg broken or gets a smack from a bullet on the face or head without the brain being injured, invariably roars or snarls loudly when hit. There was nothing more to be done that evening so I mounted my pony and galloped

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back to Sinbo where I arrived in time for dinner. On the following morning I was off again to the scene of yesterday's adventure accompanied by three military Police Sepoys, two being Gurkhas and the third a Kachin who expressed a keen desire to accompany me. They were armed with Martini Henry rifles and kukries. Three Burman villagers also begged to be allowed to come. There were seven of us all told including myself, four or five too many perhaps. It was a case of footing it of course. Elephants were not available and no one would undertake to either lend us their buffaloes or drive a herd ahead of us in order to induce the tiger to charge them and enable a shot to be got in before he got home on to some one. We had not followed the blood trail into the jungle many yards—about eighty or so perhaps altogether, when we came upon two pools of blood, and the impression of the tiger's form on the grass where he had evidently lain down and rolled about the night before. Village Police Constable Maung Po, one of the most experienced men of our party, who, like his two confréres was armed with a muzzle-loading Enfield musket, the Gurkhas having their Martini Henry rifles, now turned to me with a look and said in an undertone, 'Sir, I am afraid it is a case of having to shoot again should we come up with him, for he is alive.' I had thought this was coming.

Down to zero sank all my hopes at once of ever seeing the tiger again. However there was no getting out of it now. I decided to push on regardless of all consequences. To cut a long story short, let me say that after taking on the blood spoor for another 150 yards or so and crossing the dry bed of a small nullah a few feet in width, all traces of the wounded animal disappeared Casting carefully round for these, my men scattered slightly to right and left of me in a crescent, with no one anywhere ahead of me. We were then only about 600 yards or so from the village. The spoor led us round in a semicircle inclining back towards the village. The jungle showed signs of becoming denser than any we had as yet passed through. Two men viz., Maung Po, the village Policeman already referred to, and a Gurkha Sepoy, had branched off together to my right; two other men turned off at right angles to my left, whilst the remaining two men, a Kachin Sepoy, and a village constable, who had dropped to the rear a little, some 20 yards behind me, also turned off to the right and began walking up the dry bed of the stream we had just crossed. We were all busily engaged looking ahead and stooping every now and then scanning the ground for the lost blood spoor, and had hardly parted company many seconds when my ears were greeted by a succession of short, grunting, coughing roars from my right, in the direction taken by Maung Po and his companion. The whole affair was over in ten or fifteen seconds. According to Maung Po, the tiger which did not come along at any great pace, made a bee line for the Gurkha, who was standing some three paces from his right, having evidently spotted him from the beginning. He, unfortunately was wearing a pair of white cotton shorts, a fact which, when starting on the trail and in the excitement of the moment, had escaped my notice. Maung Po was more sensibly

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dressed in nature's garb principally, having nothing on but a dark coloured cotton loin cloth, tucked up in front and behind according to the custom of the country. He jumped to one side, and at a distance of about six paces fired at the tiger's shoulder as it came on at the Gurkha, failing however to stop it. The sepoy, according to his own statement, and that of Maung Po's elicited by me afterwards, fired at the tiger when it was three paces from him, hitting it rather low down in the face below the right eye, the bullet eventually finding a billet in the muscles of the neck, where it mushroomed without doing much harm beyond temporarily stunning the animal which still came on at a trot in a dazed manner. A third or fourth shot was fired in rapid succession, but somewhat wildly by the other two men who had gone up the bed of the nullah some way behind. Neither of these shots had the desired effect however, of disabling or turning the brute. A harmless slug from the muzzle-loading Enfield of one of the constables the man who fired the fourth shot was afterwards found embedded in the muscles of the animal's hind legs. The Gurkha, after firing, apparently lost his head. Instead of clubbing his rifle, or jumping to one side which he could easily have done, or attempting to unsheath his "Kukri", the curved heavy knife that all Gurkhas carry when in the jungle, the unfortunate man stood and thrust his rifle towards the animal holding the weapon with both arms at full length before him. The tiger seized the rifle in its teeth, and after chewing and splintering the woodwork, and scoring the barrel with its teeth, three of which were afterwards found broken in consequence, changed its grip from the rifle to the man's right thigh, the latter going over on to his back, screaming wildly. Maung Po, having witnessed this, rushed back to me yelling for assistance. We met half-way, for as soon as I heard the screams of the unfortunate man I rushed forward as quickly as the circumstances would permit till I came within sight of the tiger and at a distance of about half-a-dozen paces, put in three shots behind the shoulder.

Fortunately there was not much chance of hitting the Gurkha by mistake, as when I appeared on the scene the tiger was standing broadside on to me in an open space affording a clear view and an excellent shot. It had its head down and with closed eyes was silently chewing away at the man's right thigh whilst the Gurkha, whose screams were most unnerving, was engaged with the fingers of both hands clawing away aimlessly at the tiger's face which paid not the slightest attention to his movements but continued its horrible work. I wondered at the time that this action on the part of its victim did not infuriate the animal and make it relinquish its grip to a more vital spot higher up the man's body. Maung Po, whose companionship at this time was most acceptable, stood calmly by with an empty gun whilst I loaded and fired. My first shot did not seem to trouble the tiger at all for he paid not the slightest attention to it. It may have been a miss of course, for I was feeling far from comfortable and the whole situation was not conducive to steady shooting. My second shot hit him hard in a vital spot, for, leaping up several feet into the air, two or three seconds after the report, and snarling like the

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devil, he turned a complete somersault and fell a few yards away, clear of the prostrate man. Hurriedly ejecting the two empty cases, and loading the right chamber only, I, much to my relief, finished him with a third shot. I was only using a 12-bore ball and shot gun burning 4½ drs. of black powder, with a heavy conical bullet, a weapon hardly powerful enough for an encounter of this description. After reloading both barrels, I threw a few sticks at the body in order to make sure that the animal was really dead, and then seeing that it remained motionless, approached the wounded Gurkha, who sat up and asked for a cigarette, remarking in a broken voice that he was afraid his time had come. I cheered him up at once and told him that he would soon be alright. After removing his shorts, I examined his wounds, which at first sight, though deep and badly lacerated, showed that no vital organs had been perforated. They did not, at the time, appear likely to be fatal. Of course it is well known how quickly and easily the whole system is poisoned by bites or wounds inflicted by any of the *Felidae* and how rapidly a wounded man, even though possessed of a powerful constitution, succumbs to his wounds. Snatching a long, new, white muslin turban, some two or three yards in length, from the head of a Kachin sepoy who was standing close by, I bound up the Gurkha's wounds as quickly as possible, and had him carried into the Sinbo hospital within an hour of the occurrence. The wounds, of which there were about six in all, were situated in the front and upper part of the right thigh, between it and the groin but nearer the groin if anything, and there were also one or two deep punctures and scratches on the lower part of the unfortunate man's back. When the wounded man, before being lifted off the ground, told me he could not lift his right leg off the ground, I guessed at once that it had either been broken or dislocated at the hip. It turned out to be the latter. The femoral artery had also been severed partially as the Assistant Surgeon in charge of the hospital told me after the unfortunate man's death, which occurred the following morning at about 3 a.m., he passing away in an unconscious condition. I asked the Gurkha at the time after the accident occurred why he had not attempted to draw and use his Kukri, which he was wearing, either as a stabbing or a cutting weapon. His reply was, 'Sahib, I knew nothing. I did not know what to do, I lost my head.'

My first bullet fired from the machan had, after hitting the tiger on the top of the neck and missing the spine by a very little, continued its course, shattering the whole of the left shoulder and rendering the leg absolutely useless as the shoulder was a mass of pulp. I forgot to mention that the tiger, according to those who had seen him charging, came out on three legs, with the left leg swinging clear of the ground. No man, however good a sprinter he may be, can expect to escape from a charging tiger, even though the latter has the use of only three legs.

Although a badly wounded tiger should be followed up and killed as soon as possible after being wounded, so that the brute will not maul villagers and become, very possibly, a man-eater, he should be followed up, if possible, by the sportsman, mounted on

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1. The record tiger for Burma, 10 ft. 4 in., shot in the Myitkyina District.

2. The record tiger for Burma with the author.

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the back of an elephant, or, if these animals are not available, a herd of buffaloes should be collected and driven through the jungle where the animal may be lying up so that he may be induced to charge these and thus give those following him a chance of seeing and shooting him. For a photograph of this tiger see plate I, 1 and 2.

The circumstances under which the third tiger was shot were somewhat peculiar and thrilling.

I was out after rhinoceros, bison and elephant along the water shed of the hills which divide Arakan from Thayetmyo. It was in the month of May. We were encamped amongst the Arakan Yoma Mountains at an elevation of about 4,000 ft. A lovelier spot for a station could not be desired. Long undulating stretches of perfectly open grass country rolled away on either side of my camp for a distance of at least two miles and plenty of delightfully cool clear water was to be had within easy reach of the summit from which point a magnificent view of the surrounding country was obtainable. What with the mighty Irrawaddy to the east on one side, lying as it were at my feet some 45 miles away, with its tiny specks of sailing boats and smoking steamers and a pagoda here and there glittering along its banks, and Arakan some 90 to 100 miles to the west on the other side with its broken coast and shimmering sea clearly visible to the naked eye, and studded here and there with islands of all shapes and sizes, it was altogether a glorious scene and one alone well worth the trouble of coming to see. When I threw myself down on the ground and buried my face in the short sweet smelling crisp grass I could almost fancy myself back again amongst the bracken and heather of 'Mine ain countree'.

Next day I saw no less than ten sambar feeding along the tops of the hills in the open and during the day my bag was a very fine bull gaur, a good serow standing as high as a small donkey with 11 inch horns and a very good stag sambar. I found the ·303 with soft-nosed bullets, only the tips being exposed, very effective on serow, sambar, and boar. For elephant, bison, and tsaing, the bullet and powder charge is not heavy enough. About 1-30 p.m. on the following day whilst my hunters and I were marching along rather aimlessly down a stream, Tha Yauk, who was leading with my double 8-bore 'Paradox' suddenly drew up and, stooping, pointed to the fresh tracks of a tiger. Their wet and fresh appearance on the gravel bed of the stream showed that the animal could not be very far ahead of us, and that there was a good chance of our coming up with him provided he did not leave the stream and turn off into the jungle. I immediately changed the solid nickel-coated bullets with which the chambers of my double ·303 Enfield had been loaded, for others loaded with soft-nosed projectiles, and instructed Tha Yauk to remain handy with the double 8-bore 'Paradox' loaded with conical hollow-pointed soft lead bullets. When out shooting, I always made a point of taking out a few 8-bore cartridges loaded with large buck shot and 6 drs. of powder for an emergency of this sort. They had unfortunately been forgotten on this occasion. As a stopper in case

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of a charge from a wounded tiger at close quarters, there is nothing so effective as large buck shot when delivered from an 8-bore 'Paradox' as the pattern is generally fairly close. I then took the lead down the bed of the stream which was full of rocks and boulders and pools of water here and there. I had only gone perhaps about 150 yards, when I suddenly became aware by sounds which emanated from in front, that some animal was splashing about in a pool ahead of me. Could it be a rhinoceros? I moved quickly forward a few more paces when the head and shoulders of a tiger followed immediately by the rest of its body suddenly appeared within full view round the bend in the rocks directly facing me. The animal which was only some 20 paces off stopped dead on perceiving us. We were all in full view in mid-stream. After raising her head to its utmost, to obtain a better view of us, she took us all in with the steadfast gaze of her fierce yellow eyes for about the space of three seconds and then came towards us snarling like the devil. 'Well,' said I to myself, 'we are in for it now, this is a most unusual procedure for a tiger surprised in this fashion to take.'

But, whether after coming up to within 5 paces of us, she realised that we were not the kind of animals she had been accustomed to meet in the jungles, or whether she had got a whiff of our scent, she suddenly pulled up and sprang sideways up into the air most gracefully to a height of 8 or 10 ft. to give us a wide berth, affording me a lovely broadside shot of which I at once availed myself with the ·303. She made no sound on receiving the shot but galloped off down stream and disappeared amongst the bushes. Tha Yauk then said to me, 'Sir, you have hit her fair and square behind the shoulder and I saw the place distinctly where the bullet hit.' A statement of this description would probably stagger some people without any jungle experience and seem to be a bit too tall to swallow but it is quite true nevertheless and I am not going into further particulars here as to the why and the wherefore of things.

We then decided to call a halt to have some breakfast and a smoke. After a great many cautious manoeuvres and detours during which several trees were climbed Tha Yauk caught sight of her ladyship lying stretched out at full length on her right side. I picked up a stone and threw it at the body to make sure but she never moved. So much for the efficacy of the ·303 with soft-nosed Tweedie bullets. That is the first and the last time I ever used a ·303 on a tiger. The tigress measured 8 ft. 9 in. of which her tail was 2 ft. 4 in. (For a photograph of this tigress being skinned see Pl. II, 1.) We found on examining the pool of water from which she had emerged when we surprised her that it contained two newly-killed red land crabs of 4 and 3 in. in length. One crab was lying out of the water on the bank whilst the other one was still in the pool and had only just been killed. The contents of the animal's stomach showed that she had not had a solid meal for some time and although she was full-grown and in prime condition otherwise, she was distinctly tucked in under the ribs. Tha Yauk, one of the most experienced hunters Burma has

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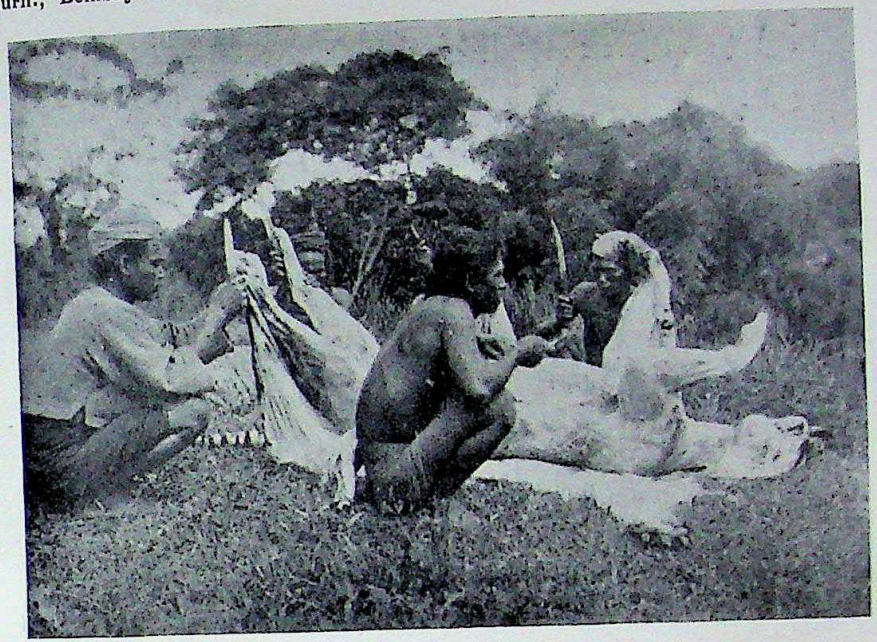
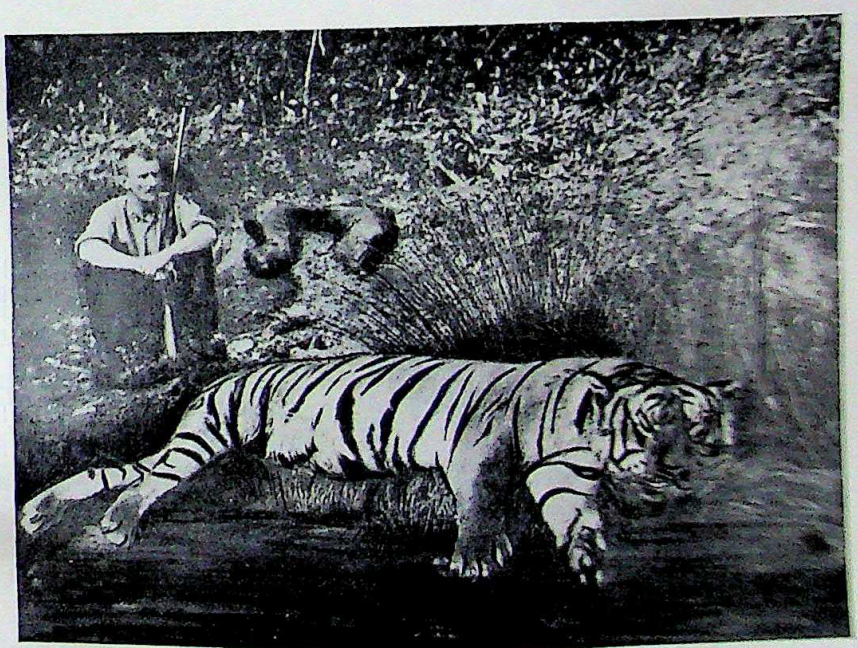


1. Skinning an 8 ft. 9 in. Tigris.



2. Tiger shot on the Ru Stream when feeding on the remains of a young elephant. Note the remains of the elephant in the background.

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ever seen, informed me that from his own experience and observations of tigers and leopards in these hills, he firmly believed that all the cat tribe, when hard pushed for food during the hot season, that is to say from April to the end of May, when they were unable to approach and stalk game as easily as at other times, owing to the dry state of the undergrowth, leaves, and twigs, were driven to eat fish, fowl, tortoises, snakes, crabs, and the like, in fact anything that was edible.

A fourth tiger was shot in Arakan under rather peculiar circumstances. I was out after rhinoceros and bison one very hot day in April. Marching well ahead of my men and baggage elephants along the banks of the Ru stream accompanied by a couple of Kami hunters, I caught sight of something red glistening in the sun in mid-stream. It turned out to be the head and neck of a tiger sitting submerged in a pool of water on a rock. The range being about 80 to 90 yards the shot was not an easy one as there was a nasty reflection or shimmer from the water owing to the sun. As it was quite impossible to get any nearer without attracting the tiger's attention I sat down on the ground and risked a shot from where I was. The tiger on the report of the rifle, a single-barelled ·500-bore burning 80 grains of cordite, by Westley Richards, disappeared into the water and sank out of view. Then to my astonishment a tigress with two cubs galloped out of a patch of jungle some 30 yards above the spot where the tiger had been fired at, followed immediately by about 20 elephants, the rear being brought up by a stag Sambar and two does. They were all travelling as fast as they could move in the same direction having evidently been disturbed by my shot. This was certainly one of the strangest processions I have ever witnessed for all 26 animals were in sight at the same time before they disappeared round a bend of the stream into the jungle. I had no time to draw a bead on to the tigress but doubled up to the pool into which the tiger had vanished and retrieved the dead animal from the bottom with much reluctance as bubbles were still reaching the surface of the water. I knew, however, that the animal if not killed outright by my shot must have been drowned. I found that my bullet had passed clean through the neck severing the vertebrae. This tiger was a very heavy massive animal measuring 9 ft. 4 in. taken straight across between uprights and had a magnificent coat as well as a very fine ruff round his face. I noticed that his stomach was considerably distended whilst a foul odour emanated from his mouth. It did not take me long to discover that he with the tigress and cubs had been feeding on a baby elephant that they had killed up a neighbouring nullah and off which he had evidently had a big feed previous to his immersion. What astonished me was how it was that two full-grown tigers and two cubs had not succeeded in demolishing the elephant entirely for it was not a large animal. A photograph of the dead tiger and the hind quarters of the baby elephant together with the author seated alongside will be found on Pl. II, 2.

Touching on the subject of sounds uttered by tigers the majority of these are well known and have been commented on by a num-

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ber of sportsmen. I have heard them all, the cat-like call made by a wounded tiger when on the point of death, a whine, a husky half suppressed kind of grunt, a snarl, a purr, a miaow and the 'tak' referred to by Mr. Peacock in page 171 of his book. I have also heard them roar continuously for no apparent reason whatsoever on getting up from their lairs at dark preparatory to making their nightly perambulations and also when they are on the move in search of food. In fact I am of opinion that they often roar in the exuberance of their own spirits. I have heard them also utter the same roar when leaving their kills near Nanyaseik in the Myitkyina District, and in the Pidaung plains of the same district, as well as in many other places on the tops of the Yoma hills between Arakan and Thayetmyo, in places where human beings were seldom met with and where they had not been much disturbed. Mr. Dunbar Brander says that when tigers roar three or four times in succession they are generally trying to get in touch with a mate. I shouldn't think tigers had much if any difficulty in finding their mates when they wanted to do so at any time, by instinct alone. Either animal as a matter of fact, should they become separated for any reason, ought to be able to find its mate. Birds seem to have no difficulty in doing so. A tiger also when on the prowl moves along through the jungle at a long steady swinging silent walk for hours on end uttering roar after roar just as the spirit moves him. I have on two occasions in the cold weather caught the male and female busily engaged *in coitu* and the row they made could be heard a long way off. On these occasions the animals have terrific scraps and kick up a devil of a noise as does the ordinary household cat. I was fortunate enough on one of these occasions in the Tavoy District to be able to shoot the male, the other animal bolting at once. I have on several occasions doubled after a solitary tiger that was on the move, roaring steadily at intervals, in the hope that I might be able to come up with and shoot the animal before the roars ceased, without however any success. Sometimes it seemed to me that I was no nearer the animal than when I started, as the roars although seeming to be quite close were much further away than I thought.

The vision and hearing of a tiger in my opinion is infinitely superior to his sense of smell which it seems to me is practically negligible and not to be compared with that possessed by a rhinoceros, elephant, bison, or tapir.

One evening about 5 p.m. a tigress passed along a game track on the top of the Yoma hills within about ten paces of where I was seated on a rock smoking a cigarette armed with only a shot gun. My camp was only distant about 250 yards. I had the shock of my life of course, but had sufficient presence of mind to remain absolutely still till she disappeared from view. If however, the wind is right a tiger is quite capable of scenting a human being or indeed any other animal.

I was once seated on a low machan about 10 ft. from the ground in some open fields waiting for a tiger to put in an appearance at his kill or rather the remains of one, viz., half a hind leg of a cow. It had little or no meat left on it and I had brought

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from a neighbouring nullah, a distance of about 250 yards to a position beside my tree as there were no suitable trees in its vicinity on which to erect a machan. There was a full moon on at the time. The tiger appeared at about 8 p.m. and was taking a bee line through the fields at a quick walk for the nullah where he had last left the cow's leg when I suppose that from a distance of about 50 yards he must have suddenly got a whiff of his kill. He turned at once sharply at right angles, and took a straight line for it without increasing his pace in the slightest. This animal gave me an easy shot as he sauntered up to annex the leg of the cow but I missed him most disgracefully and he turned a back somersault into some neighbouring undergrowth and then started 'titting' most vehemently at intervals.

The tiger in my opinion trusts more to his speed, noiseless tread, hearing, eyesight and strength, than to anything else to capture his quarry. When the ground is wet and it is raining the odour given off by a tiger, and indeed by almost all animals other than human beings, except when the latter are perspiring, is usually stronger then than at other times, and warns most animals and assists them in keeping out of harm's way. I was able after years of experience, to distinguish, especially during the wet weather, by the odour left on the grass, undergrowth, or bushes, what animal had passed as each animal has his own pronounced smell. There is for instance to begin with, no mistaking the odour of all the cat tribe. There is almost no difference between the odour left by a rhinoceros and an elephant. There is little or no difference between that left by a pig, monkey or sambar. A bear left little or no odour at all. The same remarks apply to a tapir.

I saw a tigress that I subsequently bagged stalk and kill a doe sambar during the monsoons simply by making an exceedingly rapid noiseless movement towards the deer on the crouch the whole way until the psychological moment when it literally flung itself upon its quarry with lightning rapidity, fastening its jaws upon the sambar's throat and neck and bringing it to the ground with a crash. There was only one startled bell from the sambar before the end came. One might almost say that the attack was as sudden and as rapid as the swoop of a kestrel hawk upon a pigeon or dove. The wind I also noticed was in favour of the tiger. I was within 15 yards when the sambar was seized and was lucky enough to be able to bag the tiger with one shot through the head with a 500-bore cordite rifle whilst it was still gripping the sambar by the throat. One paw of the tiger was over the neck and back of the sambar whilst the other, the left one, was underneath the neck, when I fired. Had I a cinecamera with me at the time I might have been able to get some good snapshots of the scene. The sambar was kicking spasmodically for some seconds after the tiger was dead.

Tigers have a wholesome respect for bull bison and buffalo and consequently prefer to hamstring them first thus disabling them before delivering the *coup-de-grace* at the throat. I have noticed on several occasions that the hind legs of bullocks had been broken when they have been attacked by a tiger but have

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not always been able to tell whether this had been done by the force of the tiger's weight on the body of the bullock and the stumbling gait of the latter when the tiger sprang upon and seized it, as fang and claw marks were not always visible on the hind quarters. There is no doubt however, that tigers as well as leopards do not kill animals in a uniform manner. Their favourite method in my opinion, and I have inspected many head of bullocks, buffaloes, mules and ponies that had been killed by tigers, is to kill by seizing the head or throat of nearly every animal other than a buffalo or a bison.

I do not think that the sense of smell of the leopard is any greater than that of the tiger. He is certainly a far more wary animal and is quieter in his movements and more cunning in his approach towards a kill. Under certain conditions both tigers and leopards will visit a kill even though they may get a whiff of their enemy—man, provided they don't see him. In these hard times—hard I mean for the *Felidae*—they are continually meeting the genus *Homo* and his scent so often, that they are getting more accustomed to it, and sometimes accordingly disregard it. This applies more to the unsophisticated tiger or leopard, by which I mean those animals that have never been fired at before. They usually fear nothing and often just come on up to the kill regardless of the scent of a human being. The cunning tiger, i.e., the animal that has been fired at, and hit, or missed many times, often does not come near a kill after he has had his first meal of it, and certainly rarely, if ever, comes up to a kill that has been handled or moved to a more favourable position for the erection of a 'machan'. It really makes no difference to a tiger that has never been shot at in Burma how much the kill has been handled or even removed to a new position. He turns up just the same, but I understand the reverse is more often the case in India. Is this because there are fewer unsophisticated tigers in India than in Burma and that the tigers in India are more harassed than those in Burma?

Some tigers have been shot with a lamp placed over a kill to light it and the tiger up. 90 per cent of tigers and leopards will never go near a kill with a lamp over it. An electric contrivance turned on after a tiger or leopard has arrived at the kill dazzles the animal long enough to enable the sportsman to get in a shot. Tigers and leopards are often dazzled and remain motionless on a road at night and can be approached to within a few yards by a car with its head lights full on. They are generally shot with ease but this form of sport is hardly legitimate.

I personally have never shot either a tiger or a leopard from a car or from a machan with an electric projector or contrivance. I have stated before in this article I do not consider it more unsporting to use an electric contrivance or torch from a machan when shooting at a tiger than if one was shooting at a tiger from a machan by moonlight. In the first case, with a torch, or other electric contrivance, one has a better chance of killing the animal outright, whilst in the second case the animal is more likely to get away wounded when fired at by moonlight.

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I am afraid I cannot quite see eye to eye with what Mr. Peacock says on page 170 of his excellent book 'A Game book for Burma and Adjoining Territories' regarding the height he considers 'machans' should be from the ground and the distance the sportsman should be seated on the machan from the kill. Thirty feet he says should be the height of a machan. This it seems to me is overdoing it a little. I never had a machan higher than 15 to 20 ft. at the very most from the ground. The machan from which I sat up alone and shot the tiger in Myitkyina which killed the Gurkha was only situated about 8 ft. from the ground and I suppose about 7 or 8 yards from the kill. In this case I had to be as low as possible to be able to see the kill as well as the tiger, there being no moon whatsoever.

As stated before, if a tiger is going to wind a man on a machan who is smoking a cigarette, he will do so just as easily as if the man did not smoke at all. In other words if he is capable of getting one scent he will get the other also. A sportsman may have the luck to be winded by a tiger and he may not. If the tiger is returning shall we say to his kill along a 100 ft. high ridge which happens not to be very far from the machan, whilst the sportsman's scent happens to be blowing along this ridge from the machan in the direction of the approaching tiger, the latter will in all likelihood get the scent and be suspicious and not turn up at the kill at all. It is all luck. There is no understanding the ways of some tigers. Sportsmen have shot tigers from a pit dug in the ground over and over again. I have had many disappointments sitting up for tigers that have never turned up whilst on other occasions I have also had the most glorious luck. My want of luck on those occasions where tigers ought to have turned up and didn't, was not due to any carelessness on my part or through my not taking proper precautions. But I must confess that on the successful as well on the unsuccessful occasions I invariably smoked cigarettes when in the machan but never allowed the butts to reach the ground. Life would not be worth living, I am afraid, if one were to take all one's pleasures too seriously and make tiger shooting for instance from a machan at night an exact science or a matter of life and death.

It is not perhaps generally known and this may perhaps be the first time it has ever been reported viz., that tigers sometimes roll playfully on any offal, filth, decayed substance or animal droppings they may come across in their wanderings as do dogs, especially in the early morning, after rain has fallen the night before. This was brought to my notice very clearly on one occasion. I was making my way through the jungle on foot alone one morning early with the intention of visiting a clearing where the grass had recently been burnt in the hope that I would find a very large solitary bull tsaing whose tracks I had often come across. En *route* when within about 25 yards of the 'Kwin', (Burmese for clearing) I had to jump a small nullah. Just as I cleared it and had landed on the other side I caught sight of a tiger out in the open clearing rolling about on his back, from side to side, in a most playful manner, with all four legs in the air, exactly as a

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dog does when he rolls on something really smelly, the more smelly the better. The thud of my feet, as I landed, unfortunately, disturbed him for he sprang up and made off at a terrific pace after uttering a single 'whoof'. I went up to the spot and found that the tiger had been rolling on fresh elephant droppings. My baggage elephants had passed through the clearing the evening before and rain had fallen the same night.

With regard to the subject of maneaters and as to how they begin to get a liking for human flesh I would say that my experience has taught me that it may be due to several causes. Tigers do not necessarily become maneaters because they are unable to pull down game through old age, or failing vision, or bad hearing, although there is no doubt that cases of this sort do occur from time to time, poor vision being as much responsible as anything else. Tigers are more likely to go in for killing human beings when they have been crippled or disabled in some manner, say, through a bullet wound or through a scrap with another tiger, boar, or bison. The principal reason in my opinion however why tigers become maneaters is because the tiger kills a human being in mistake for a four-footed animal. He then finds what an easy matter it is to kill the two-footed animal as compared with the four-footed beast and sticks to the killing of human beings. For instance I know of several cases in Burma where Burman hunters have been carried off by tigers when they have been crawling over the ground to stalk say a sambar, pig, or barking deer. They in turn have been stalked and killed by a tiger which in the first instance mistook them for four-footed animals. Had these tigers however, when stalking these hunters, got a whiff of human scent, in all likelihood, they would have made off at once and not continued the stalk. A tiger unless he is a maneater is more afraid of a human being than he is of anything else in the world. I know also of several cases in Burma where villagers sitting alone in thickets in the jungle with a decoy cock with the object of attracting and snaring jungle fowl have been carried off by prowling tigers. They have mistaken the solitary watchmen with their decoy cocks, for four-footed animals. The difference in the tenderness or flavour of the meat of a human being as compared with that of a four-footed animal has nothing whatsoever to do with it. A maneater in due course if not accounted for pretty soon terrorizes the neighbourhood and becomes an adept at the game. Besides getting very wily and one never can tell where or at what hour he will next turn up and carry of a victim, he becomes bolder and bolder after every kill.

I was fortunate in being able to kill a maneating tiger in the Thayetmyo District of Lower Burma many years ago. He had accounted for several villagers. He used to frequent a certain cart track in the jungle some miles from any village and then walk up to and grab hold of any one that came along. At other times he would be heard of along another cart track some miles away in a different part of the district. When I thought it was the turn of the first cart road to get another visit I began to walk up and down it for several miles alone backwards and forwards

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between the hours of 4 and 6-30 p.m. I was armed with a double .500-bore rifle. I had been perambulating along the road for three successive days when on the fourth day he trotted out of the jungle on the road in front of me some 70 to 80 yards away. I stepped behind a tree and waited for him to come up feeling far from happy. On catching sight of me in the distance he gave a couple of low grunts and began to trot towards me slowly down the track. I waited till he got within about five paces and was then fortunately able to brain him with one shot through the right ear making him turn a complete somersault. He was found to be a heavy male 9 ft. long in splendid condition with a beautiful coat.

Tigers are also sometimes driven to killing human beings owing to the scarcity of game and absence of village cattle.

The habit tigers, as well as leopards, have of easing themselves on a bare patch of ground which they have scraped clear is exactly the same as that of an ordinary household cat. There is no difference at all. The operation is sometimes accompanied by a faint 'miaow', whine, or grunt in the case of all three animals. I saw from a machan in which I was seated a tiger relieve himself within a yard or two of his kill in broad daylight in the Myitkyina District. This tiger was shot by me at the same moment through the head, the time being about 4-30 p.m. The animal gets into a peculiar cramped crouching attitude as if about to become paralized in the hind quarters, the two hind feet moving backwards and forwards, the tail twitching at the same time with peculiar spasmodic jerks. I saw and bagged a black leopard which was performing the same operation, in exactly the same manner as a tiger along a jungle path a few yards in front of me before I shot it. I raked him with a soft-nosed ·303 bullet which entered the spine at the root of the tail and broke up in his chest killing him practically on the spot.

In order to see whether there was any difference between the methods of a cat, tiger, and leopard I watched a black cat of mine ease itself on numerous occasions and came to the conclusion that all three animals behaved more or less in a similar manner when easing themselves. There isn't a more cleanly animal in the world, so far as outward appearances are concerned than the household cat. Although its fur is full of millions of germs, it has as perfectly groomed a coat as any leopard or tiger, except that the two last-named have numerous ticks on them which the first-named seldom if ever has. Because of this incessant use of the tongue and saliva upon the coats of all three of these animals they are rarely attacked by any skin disease. You will see many dogs with skin-disease wild as well as tame and also jackals for I have shot wild dogs suffering from skin-disease, but rarely if ever any of the cat tribe owing to this method of cleansing the coat with the tongue and saliva. As a matter of fact any one that handles a cat's fur at all should wash his or her hands at once afterwards before smoking or eating food as there is no knowing what diseases are communicated through handling their fur. I expect the same remarks apply to the fur of the *Felidae* but not to the same extent.

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All the *Felidae* will eat putrid meat when they are hungry and they all clean and sharpen their claws on trunks of trees.

A tiger has no cut and dried methods of finding his prey when he is hungry but there is no doubt that he often visits salt-licks at night in the hope of seizing a sambar, bison calf, or perhaps a barking deer. Pigs do not usually visit a salt-lick as they do not eat the saline earth or partake of the waters as do all ruminants. The only animals that visit salt-licks in Burma are the deer tribe, elephant, tapir, rhinoceros and all the bovines such as gaur and tsaing. I have, however, seen jungle fowl, peafowl, imperial, as well as green pigeon, and also the Gibbons sip at the waters of a salt-lick. There is some mysterious fascination about a salt-lick that seems to attract all kinds of animals and birds to it, whether they do or do not partake of the waters or salty-earth there, for I have often found all sorts of birds there including hornbills and heard a regular twittering and chattering going on.

I remember one evening about 6 p.m. in the Myitkyina District visiting a jheel where I was told we might find a good sambar stag towards sunset feeding on the young grass growing on the edge of the water. We were walking slowly round the jheel which was only about 200 yards in length by about 150 yards wide when a flock of cotton teal got up with a splash and went off into space with a whirr. Almost immediately after I caught sight of a tiger running up out of the jungle towards the edge of the jheel on the side opposite to that on which I was standing with its head up in an expectant attitude. He was off like a flash however when he caught sight of me and my hunter, and unfortunately, I was unable to draw a bead on him. There was no doubt that this tiger was questing for food and was on the watch at the jheel and knew right well that the teal had been disturbed by some animal which he came out with the intention of bagging.

A tiger seems to wander aimlessly about at night along pathways, forest firelines, the beds of streams, cart tracks or even public high roads for miles at a time. He may or may not be questing for food. It just depends when he last had a meal. Any way he wanders long distances during the night and does not necessarily return the same night but lies up in the thickest, coolest, and darkest place he can find where he is not likely to be molested till dark when his peregrinations begin again. Should he come upon anything to kill on these occasions he does so and has a meal, but he does not seem to me to put himself about a great deal to obtain it. It is only when he finds game is scarce and gets very hungry that he begins stalking and killing village cattle. A tiger it seems to me can carry on for at least a week if not more without having a meal. Tigers do not like the damp at all and they invariably move into the hills if there are any in the vicinity in preference to living in flat country when the rains are on. In Burma, at any rate, tigers that come down from hilly country to kill cattle or find game, invariably go back into the hills towards the beginning or middle of July. This applies to bison as well.

Tigers seem to be extremely fond of pork for they will follow

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a sounder of pigs for days together and make several kills one after the other, and there is no doubt that the tiger that once starts killing pigs will stick to pork as long as he can, even though it should be village pork. A tiger, as indeed a leopard, rarely bounds or gallops after any animal he has missed in his first spring. If he does not succeed in seizing his prey in the first two or three bounds he usually relinquishes it. He loves a bath as much as any other animal when the weather is warm and his stomach is full of meat and is often found immersed in a stream up to his neck. As is well known he is a powerful swimmer. I was once coming down the Lemro River in Arakan in a dug out spinning for mahsir with a spoon about 10 a.m. one morning when I was suddenly startled by hearing something rise out of a pool of water amongst some rocks to my right some ten to fifteen paces off. Presently a tiger rose out of the water and trotted slowly up the bank out of sight into the jungle before I could pick up and use a .355 Manlicher rifle that I had in the boat at the time. We were going down rather a rapid run at the time and the dug out was wobbling about a bit, whilst I was expecting to get into a good Mahsir at any moment. The rapid and the pool at the end of it was a particularly famous one for big fish I having caught in it not many days before, a 48½ pounder.

I once came face to face to within about 4 yards of a tiger. I was hurrying along back to camp at dusk with only a walking stick in my hands as camp was within 300 yards. All the animal did was to give a snarl and a 'whoof' as he sprang back off the track into the jungle where I heard him bounding away through the undergrowth for the first 25 or 30 yards when all sounds ceased. There might have been a very different story to tell had it been a tigress with cubs.

With regard to the colouration of tigers and leopards I have shot tigers in heavy ever-green jungle as well as in scrubby light jungle and I do not think there was much if any difference in the coats or colouration of the animals. There is no doubt however that the hill leopard that inhabits dense ever-green clad hills and forests usually possesses a magnificent dark coat with very fine dark-coloured clearly defined rosettes as compared with his brother of the plains. A tiger or leopard shot in any place where frost or a good cold weather is experienced usually possesses a better coat from December to the middle of February than during the rest of the year. I have also noticed that tigers which inhabit very steep hilly country are not as a rule as large as those animals found in low-lying dense ever-green tree forests.

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THE FLORA OF WAZIRISTAN.

BY

THE LATE E. BLATTER, S.J., PH.D., F.L.S. and J. FERNANDEZ.

PART V.

(*Continued from page 424 of this volume*).

ROSACEAE[1]

2,000 species.—Cosmopolitan.

PRUNUS (Tourn.) L.

85 species.—N. temperate; a few tropical.

Prunus communis Hudson Fl. Angl. ed. 2, i, 212.
Vernacular name: Plum, Prune, Sloe, Damson; Alicha (Waziri).
Locality: *N.W.*: Boya, 4,000 ft., cultivated (F. 898 !).
S.W.: Wana, 4,500 ft., cultivated (F. 3580 ! 3612 ! 3663 ! 3665 ! 3670 ! 3671 !).
Distribution: Indigenous in Europe and W. Asia. Cultivated in Baluchistan, Afghanistan, Punjab, and the N.-W. Himalaya.

Prunus leucophylla Blatter in Journ. Ind. Bot. Soc. ix (1930) 206.
Vernacular name: Mamumiae (Waziri).
Locality: *N.W.*: Boya, on hills, 4,000 ft. (F. 424 ! 425 !).—Razani, 5,000 ft. (F. 2751 !).
Young fruit in April.
Uses: Fruit eaten.

Prunus eburnea Aitch. in Journ. Linn. Soc. xviii (1880) 50.
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15625 !).
Flowers: 19-5-1895 (Shakai).
Distribution: Afghanistan, Persia.

Prunus Padus L. Sp. Pl. 473; Stewart Punj. Pl. (1869) Rosac. 83; Aitchis. Fl. Kuram Valley (1880) 51; Brandis Ind. Trees (1911) 280.—*P. cornuta* Wall. Cat. (1828) no. 716; Parker For. Fl. Punj. (1918) 205.
Vernacular name: Bird Cherry.
Locality: *S.W.*: Pre Ghal (Hay !, J. Williams 7806 !).
Distribution: Kuram Valley, Trans-Indus, Himalaya, Hazara to Sikkim, 4,000-10,000 ft. (Brandis).

Prunus Amygdalus Stokes Bot. Mat. Med. iii, 101.
Vernacular name: The Almond tree; Badam (Waziri).
Locality: *S.W.*: Wana, 4,500 ft., cultivated (F. 3587 ! 3659 !).—Near Razmak (Stewart).
Distribution: Indigenous in W. Asia and the Kuram Valley. Cultivated in the Mediterranean region, Persia, Afghanistan, Baluchistan, Punjab, Kashmir.

Prunus persica Stokes Bot. Mat. Med. iii (1812) 100.
Vernacular name: The Peach; Shavtalai, Shevtali, Perai kalkundie (Waziri).
Locality: *N.W.*: Boya, 4,000 ft. (F. 896 ! 1365 ! 1376 ! 1377 !).—Miram Shah, 3,000 ft., cultivated (F. 1073 ! 1088 ! 1090 !).—Razani, 5,000 ft. (F. 2102 ! 2103 ! 2106 ! 2107 ! 2108 ! 2109 ! 2759 ! 2825 ! 2840 ! 2884 !).

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[1] This order should be inserted after the *Leguminosae*.

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18. *Capparis decidua* Edgew. on precipitous left bank of Volam River near Shewa Post.

19. From bank of Kuram River up the river due North. In bed *Tamarix*. In the middle distance Shewa Village with Mulberry trees.

Photos by J. Fernandez.

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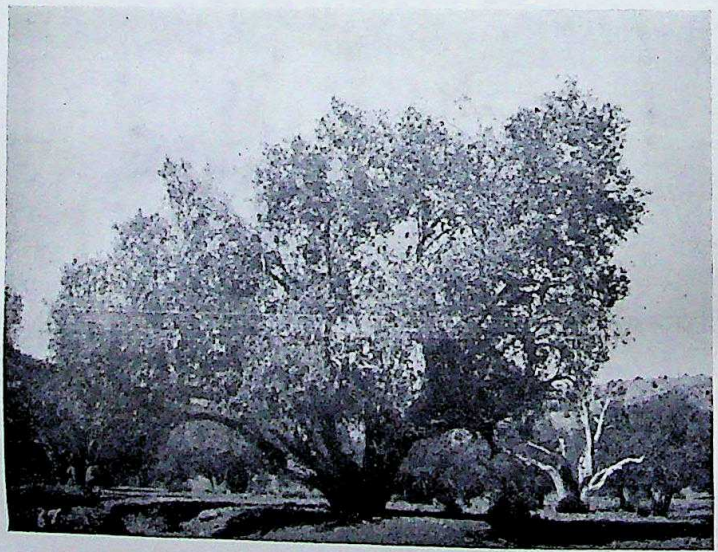
20. Out-crops in a vast plain W. of Spinwam Fort.



21. River bed of Khunai. Old *Olea cuspidata* Wall. with *Viscum album* L.
Photos by J. Fernandez.

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S.W.: Wana, 4,500 ft., cultivated (F. 3633 ! 3666 ! 3668 !).—Above Anai Gorge (Stewart).—Kaniguram, about 6,500 ft. (Stewart).—Between Makin and Razmak (Stewart).

Flowers: March.

Unripe fruit in June.

Distribution: Probably a native of China. Cultivated in N. India, in the Himalaya up to 10,000 ft., Baluchistan, W. Asia, Europe.

Prunus armeniaca L. Sp. Pl. i (1753) 474.

Vernacular name: Apricot; Mandata (Waziri).

Locality: *N.W.*: Miram Shah, 3,000 ft. (F. 1072 ! 1075 ! 1082 ! 1083 !).—Boya, 4,000 ft., cultivated (F. 1344 ! 1345 ! 1346 ! 1368 ! 1369 !).—Razani, 5,000 ft. (F. 2166 ! 2187 ! 2196 ! 2752 ! 2753 !).

S.W.: Wana, 4,500 ft., cultivated (F. 3604 ! 3613 ! 3669 !).—Near Kaniguram, at 6,500 and 8,200 ft. (Stewart).

Young fruit in April.

Fruit: June.

Distribution: Perhaps indigenous in the Caucasus. Bailey thinks it is indigenous in Siberia (Dahuria, Manchuria) to China. Commonly cultivated in Europe, W. and Central Asia, Baluchistan, N.-W. Himalaya, Tibet to 12,000 ft. and in the plains of Punjab.

Spiraea L.

50 species.—N. temperate regions.

Spiraea sorbifolia L. Sp. Pl. 490; Brandis Ind. Trees (1911) 283.—*S. Lindleyana* Wall. Cat. (1828) no. 703; Stewart Punj. Pl. (1869) 88; Parker For. Fl. Punj. (1918) 212.

Vernacular name: Balanza (Waziri).

Locality: *N.W.*: Razani, on stony slopes, 5,000 ft. (F. 2766 ! 2783 ! 2841 ! 2842 ! 2845 ! 2859 ! 2869 ! 2871 ! 2887 ! 2889 ! 2891 ! 2905 ! 2908 !).—Razmak, growing on lower slopes, 6,500 ft. (F. 1626 ! 1632 !).

S.W.: Near Kaniguram, about 6,500 ft. (Stewart), also at 8,200 ft. (Stewart).

Fruit of previous year found in April.

Distribution: Punjab, N.-W. Himalaya, 5,000-11,000 ft., Trans-Indus.

Spiraea brahuica Boiss. Fl. Or. ii (1872) 690.

Locality: *S.W.*: Pre Ghal (Duthie's Collect. 15799 !).

Flowers: 15-5-1895 (Pre Ghal).

Distribution: Baluchistan.

Rubus (Tourn.) L.

225 species.—Cosmopolitan, especially N. temperate regions.

Rubus fruticosus L. Sp. Pl. (1753) 493; Aitchis. Fl. Kuram Valley (1880) 52; Brandis Ind. Trees (1911) 286; Parker For. Fl. Punj. (1918) 209.

Vernacular name: European Blackberry; Spangar (Waziri).

Locality: *N.W.*: Datta Khel, near village, 4,500 ft. (F. 1302 !).

S.W.: Above Anai Gorge, about 4,000 ft., hanging in masses from the cliffs (Stewart).—Kaniguram, about 8,200 ft. (Stewart).

Flowers: May 1860.

Distribution: Europe, N. and W. Asia, Afghanistan, Kuram Valley, Hazara, Kashmir, Salt Range.

Rubus gracilis Roxb. Hort. Beng. (1814) 39.—*R. niveus* Wall. Cat. (1828) no. 734; Aitchis. Fl. Kuram Valley (1880) 52 (var.); Parker For. Fl. Punj. (1918) 210.

Vernacular name: Spangair (Waziri).

Locality: *N.W.*: Razani, near stream, 5,000 ft. (F. 2977 ! 2978 !).

S.W.: Razmak, 6,500 ft. (F. 1766 ! 1771 !).

Distribution: Kuram Valley, Trans-Indus, Outer Himalaya from Kashmir to Bhutan, 6,000-12,000 ft., Manipur.

Rubus sp.

Locality: *N.W.*: Boya, on stony ground, 4,000 ft. (F. 1353 !).

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FRAGARIA (Tourn.) L.

46 species.—N. hemisphere, Chili.

Fragaria indica Andr. Bot. Rep. t. 479; Stewart Punj. Pl. (1869) 80; Aitchis. Fl. Kuram Valley (1880) 52.

Locality: *S.W.*: Barrarra Pass (Stewart).

Distribution: Afghanistan, Kuram Valley, temperate and subtropical Himalaya from the Punjab to Assam, Khasia Hills, Malay Islands, Japan, Corea, Formosa.

Fragaria visca L. Sp. Pl. 494; Stewart Punj. Pl. (1869) 80; Aitchis. Fl. Kuram Valley (1880) 52.

Locality: *N.W.*: Razani, 5,000 ft. (F. 2953 !).—Miram Shah, planted (B. & F. 644 !).

S.W.: Near Kaniguram brook (Stewart); Razmak, 6,500 ft. (F. 1643 ! 1657 ! 1683 ! 1688 ! 1692 ! 1701 ! 1706 ! 1733 ! 1751 ! 1878 ! 1879 ! 1880 ! 2231 ! 2506 ! 3114 ! 3117 !).—Shuidar Peak near Razmak, 10,980 ft. (F. 2506 !).—Pre Ghal (Duthie's Collect. 15612 !).

Flowers: May, 26-5-1895 (Pre Ghal).

Distribution: Europe, Canaries, N. Africa, Afghanistan, Kuram Valley, temperate Himalaya, N. temperate zone, Java.

POTENTILLA L.

300 species.—Nearly cosmopolitan, chiefly N. temperate and arctic regions.

Potentilla fragarioides L. Sp. Pl. (1753) 496; Boiss. Fl. Or. Suppl. (1880) 234; Burkill Fl. Pl. Baluch. (1909) 30; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 34.

Vernacular name: Serai (Waziri).

Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15698 !).

S.W.: Razmak, 6,500 ft., common (F. 2030 ! 2270 ! 2295 ! 3074 ! 3268 ! 3276 ! 3282 !).

Flowers: 30-4-1895 (Shakai); May.

Distribution: Kuram Valley, Baluchistan, temperate Himalaya, Turkestan, E. Russia, Siberia, China, Japan.

Potentilla sericea L. Sp. Pl. (1753) 495; Boiss. Fl. Or. ii (1872) 709; Aitchis. Fl. Kuram Valley (1880) 53; Hook. f. in Fl. Brit. Ind. ii (1878) 354 (*excl. syn. P. soongarica* Bunge); Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 16; T. Wolf Monogr. Gattg. Potentilla p. 161, no. 58, in Luerssen Biblioth. Bot.

Locality: *S.W.*: Razmak, 6,500 ft. (F. 1907 ! 1914 !).

Flowers: May.

Distribution: Caucasus, Afghanistan, Kuram Valley, W. alpine Himalaya from Kashmir to Kumaon, Soongaria, N. China, N. America.

Potentilla reptans L. Sp. Pl. (1753) 499; Boiss. Fl. Or. ii (1872) 723; Aitchis. Fl. Kuram Valley (1880) 53; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 35; Blatter Fl. Arab. pt. 2 (1921) 190.

Locality: *S.W.*: Razmak, 6,500 ft. (F. 3188 ! 3198 !).—Kaniguram (Duthie's Collect. 15751 !).

Tank: Near Tank.

Flowers: 14-5-1895 (Kaniguram).

Distribution: Europe, N. Africa, Abyssinia, Persia, Turkestan, Afghanistan, Kuram Valley, Siberia, N. China, Japan.

Potentilla supina L. Sp. Pl. (1753) 497; Boiss. Fl. Or. ii (1872) 725; Aitchis. Fl. Kuram Valley (1880) 53; Burkill Fl. Pl. Baluch. (1909) 30; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 25.

Vernacular name: Yezhei (Waziri).

Locality: *N.W.*: Razmak, 6,500 ft. (F. 1583 ! 1584 ! 1600 ! 1621 ! 1647 ! 1667 ! 2336 !).

S.W.: Zam (J. Williams 7810 !).

Tank: Near Tank (J. Williams 7809 !).

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Flowers: May (Razmak); June (Zam); August (Tank).
Distribution: Cape, tropical Africa, N. Africa, Central and S. Europe, Arabia, Mesopotamia, Turkestan, Afghanistan, Baluchistan, warmer parts of India.

Potentilla sp.
Locality: *N.W.*: Boya, along Tochi River, 4,000 ft. (F. 535 !).
Flowers: April.

Poterium L.

1 species.—Italy, E. Mediterranean.

Poterium sanguisorba L. Sp. Pl. 994; Boiss. Fl. Or. ii (1872) 733; Aitchis. Fl. Kuram Valley (1880) 54; Aitchis. Bot. Afgh. Del. Com. (1888) 62.
Locality: *S.W.*: 8 miles below Kaniguram village (Stewart).
Distribution: Europe, Caucasus, Persia, Afghanistan, Punjab, N. Asia.

Sanguisorba Rupp. ex L.

30 species.—N. temperate regions.

Sanguisorba sp.
Locality: *S.W.*: In the upper regions (Stewart).

Rosa Tourn. ex L.

150 species.—N. temperate and on tropical mountains.

Rosa Beggeriana Schrenk in Fisch. & Mey. Enum. (1a) pl. nov. (1841) 73; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 38.—*R. Silverhjelmi* Schrenk in Bull. Ac. St. Petersb. ii (1844) 195.—*R. Lehmanniana* Bunge Reliq. Lehm. no. 468 in Mém. Sav. Etr. Petersb. xii (1851) 287.—*R. anserinaefolia* Boiss. Diagn. ser. i, 6, 51, Fl. Or. ii (1782) 677; Aitchis Bot. Afgh. Del. Com. (1888) 63; Burkill Fl. Pl. Baluch. (1909) 30; Brandis Ind. Trees (1911) 287.
Locality: Waziristan, 5,000 ft. (Stewart ex Hook. f.).
Distribution: Persia, Turkestan, Afghanistan, Baluchistan, Kuram Valley.

Rosa Webbiana Wall. Cat. (1828) no. 683; Aitchis. Fl. Kuram Valley (1880) 54; Parker For. Fl. Punj. (1918) 218; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 38.—*R. maracandica* Bunge Reliq. Lehm. no. 467.—*R. clasmacantha* Trautv. Ind. Sem. Hort. Petrop. (1868) 25.
Vernacular name: Perai sakharzie (Waziri).
Locality: *S.W.*: Razmak, 6,500 ft. (F. 2793 ! 2814 !).—Pre Ghal (Duthie's Collect. 15611 !).
Flowers: 16-5-1895 (Pre Ghal).
Distribution: Turkestan, Kuram Valley, Baluchistan, Inner and N.-W. Himalaya up to 13,500 ft.

Rosa sp.
Locality: *S.W.*: Jandola, 2,200 ft., cultivated (F. 1527 !).

Neurada L.

1 species.—Mediterranean to Indian desert.

Neurada procumbens L. Sp. Pl. (1753) 441.
Locality: *Tank*: Near Tank (Stewart).
Flowers: April 1860 (Tank).
Distribution: Sind, Baluchistan, Rajputana Desert, Punjab, Afghanistan, Persia, Arabia.

Cydonia Tourn. ex Mill.

5 species.—Europe, N. Asia.

Cydonia oblonga Mill. Gard. Dict. ed. 8 (1768) no. 1; C. K. Schneider Handb. Laubholzk. 654; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. i (1909) 46.—*C. cydonia* Pers. Syn. ii (1807) 40.—*C. vulgaris* Pers. Syn. ii *in corrigend.*; Boiss. Fl. Or. ii (1872) 656; Brandis Ind. Trees (1911) 289; Parker For. Fl. Punj. (1918) 220.

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Vernacular name: The Quince; Behi (Waziri).
Locality: *N.W.*: Miram Shah, cultivated, 3,000 ft. (F. 1084 ! 1093 !).
Young fruit: April.
Distribution: Probably wild in Persia and Turkestan. Cultivated in S. Europe and in N.-W. India. 'Rarely if ever self-sown.'—Parker.

PYRUS (Tourn.) L.

65 species.—N. temperate regions.

Pyrus communis L. Sp. Pl. (1753) 479.
Vernacular name: The Pear; Amrith (Waziri).
Locality: *N.W.*: Miram Shah, 3,000 ft., cultivated (F. 1071 ! 1074 ! 1077 ! 1087 !).
Distribution: Indigenous in E. and Central Europe and W. Asia, cultivated in the N.-W. Himalaya, also in Baluchistan.

Pyrus malus L. Sp. Pl. (1753) 479.
Vernacular name: The Apple; Manna (Waziri).
Locality: *N.W.*: Miram Shah, 3,000 ft., cultivated (F. 1076 ! 1081 !).—Boya, 4,000 ft. (F. 893 !).
S.W.: Wana, 4,500 ft. (F. 3537 ! 3588 ! 3635 ! 3667 !).—Razmak, 6,500 ft. (F. 2847 !).
Distribution: Native of Europe and W. Asia, perhaps also of the N.-W. Himalaya.

Pyrus parvifolia Blatter in Journ. Ind. Bot. Soc. ix (1930) 207.
Vernacular name: Sherva (Waziri).
Locality: *N.W.*: Razani, 5,000 ft. (F. 2073 ! 2117 ! 2171 ! 2221 ! 2931 !).
S.W.: Razmak, 6,500 ft. (F. 1693 ! 2786 ! 2811 ! 3084 ! 3100 ! 3189 ! 3312 ! 3344 ! 3346 !), Razmak, open stony ground (F. 2689 ! 3345 !).
Flowers: April.
Uses: Fruit eaten.

CRATAEGUS Tourn. ex L.

100 species.—N. temperate regions.

Crataegus sp.
Locality: *S.W.*: About Kaniguram (Stewart).

COTONEASTER Rupp.

50 species.—N. temperate regions.

Cotoneaster microphylla Wall. in Lindl. Bot. Reg. (1827) t. 1113, **va buxifolia** Parker For. Fl. Punj. (1918) 228.—*C. rotundifolia* Wall. Cat. no. 663; Stewart Punj. Pl. (1869) 79.—*C. buxifolia* Wall. Cat. no. 661; Hook. f. Fl. Brit. Ind. ii (1878) 387 (*partim*).
Locality: *S.W.*: On a wide shingly plateau at Tandachina (Stewart).
Distribution: Punjab, Garhwal, Kumaon, Sikkim.

Cotoneaster integerrima Med. Ges. d. Bot. (1793) 85, **var. α**; C. K. Schneider Ill. Handb. d. Laubholzk. 5, Lief. 748; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 42; Parker For. Fl. Punj. (1918) 227.—*Mespilus Cotoneaster* L. Sp. Pl. (1753) 479 (*partim*).—*M. Cotoneaster* L. *var. rubra* Ehrb. Beitr. iv (1789) 18.—*Cotoneaster vulgaris* Lindl. in Trans. Linn. Soc. xiii (1821) 101; Stewart Punj. Pl. (1869) 80; Aitchis. Fl. Kuram Valley (1880) 56; Burkill Fl. Pl. Baluch. (1909) 32.
Locality: Waziristan (ex Brandis, ex Hook. f., Stewart).
Distribution: Europe, W. Asia, Turkestan, Kuram Valley, Baluchistan, Punjab, Kashmir, Garhwal, W. Tibet.

Cotoneaster racemiflora K. Koch Dendr. i (1869) 170; C. K. Schneider Ill. Laubholzk. fasc. 5, 754; Fedtschenko & Fedtschenko Consp. Fl. Turkest. pt. 3 (1909) 43.—*R. racemiflora* K. Koch. *var. Kotschyi* C. K. Schneider l.c. 754.—*Mespilus racemiflora* Desf. Pl. Hort. Paris ed. iii (1829) 409.—*Cotoneaster Fontanesii* Spach Hist. Veg. ii (1834) 77.—*C. Fontanesii var. songorica* Rgl. Act. Hort. Petrop. ii, 313.—*C. nummularia* Fisch. & Mey. Ind. Sem. Hort.

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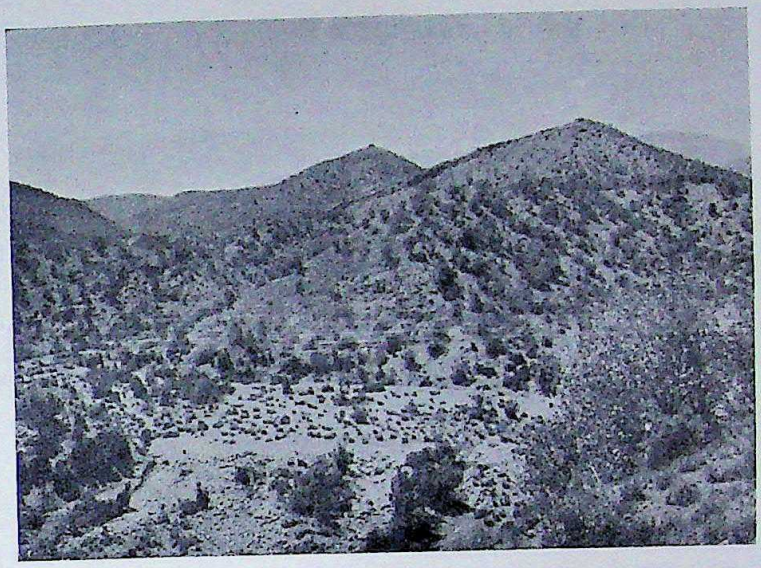

22. From a hill S. of Razani due S.W. mostly *Quercus* forest with *Olea cuspidata* Wall. In the foreground a nala with tufts of grass, *Olea* and *Sophora*.

23. Bank of Khaisora River with *Olea cuspidata* Wall, *Monotheca buxifolia* Dene., *Daphne oleoides* Schreb, *Acacia modesta* Wall and clumps of grass. *Photos by J. Fernandez.*

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Petrop. ii (1835) 31; Aitchis. Fl. Kuram Valley (1880) 56, Bot. Afgh. Del. Com. (1888) 61; Burkill Fl. Pl. Baluch. (1909) 32; Brandis Ind. Trees (1911) 295; Parker For. Fl. Punj. (1918) 228.

Vernacular name: Marmomae.

Locality: *S.W.*: Near Kaniguram, about 6,500 ft., common (Stewart).—Pre Ghal (J. Williams 7813 !).

Tank (J. Williams 9213 !).

Distribution: W. Asia, Turkestan, Afghanistan, Kuram Valley, Baluchistan, Punjab, Kashmir, Himalaya, 6,000-10,000 ft., W. Tibet.

Cotoneaster bacillaris Wall. in Lindl. Bot. Reg. (1829) ad. t. 1229.

Locality: Waziristan (ex Hook. f. vol. 2, 384).

Distribution: Temperate Himalaya 4,000-8,000 ft., Murree and Kashmir to Nepal, Salt Range 1,500-2,500 ft.

UMBELLIFERAE[1]

2,700 species.—Cosmopolitan, chiefly N. temperate.

Vicatia DC.

3 species.—Himalayas.

Vicatia coniifolia DC. Prod. iv (1830) 213.

Locality: *S.W.*: Pre Ghal (Hay).

Distribution: Himalayan region.

Bupleurum (Tourn.) L.

100 species.—Europe, Asia, Africa, N. America.

Bupleurum falcatum L. Sp. Pl. 237.—*B. marginatum* Wall. Cat. 566.

Locality: *S.W.*: Kaniguram (Stewart).—Pre Ghal (Hay).

Distribution: Himalaya, from Kashmir to Bhutan, 3,000-12,000 ft., Khasia Mts., Orient, Central Asia, S. Europe.

Carum Rupp. ex L.

20 species.—Temperate and subtropical.

Carum Bulbocastanum (L.) G. Koch Umbell. 121, ex Ledeb. Fl. Ross. ii, 249.—*Bunium Bulbocastanum* L. Sp. Pl. (1753) 243.

Locality: Waziristan (Duthie's Collect. 15674).

Distribution: Kashmir 6,000-9,000 ft., Baluchistan, N. Asia, Europe, N. Africa.

Heloscıadium Koch.

Heloscıadium nodiflorum (L.) Koch Umb. 26.

Locality: *S.W.*: Wana, stony plain, marsh, 4,500 ft. (F. 3452 !).

Flowers: 16-6-27 (Wana).

Distribution: Central and S. Europe, N. Africa, Abyssinia, Orient.

Scandix Tourn. ex L.

12 species.—Europe, Mediterranean.

Scandix pecten Veneris L. var. **brevirostris** Boiss. Fl. Or. ii, 915.

Locality: *N.W.*: Datta Khel village, 4,600 ft. (B. & F. 1490 ! 1506 !).

Flowers & Fruit: 17-4-30.

Distribution of var.: Mediterranean to Baluchistan and Afghanistan.

Prangos Lindl.

36 species.—Mediterranean, Central Asia.

Prangos pabularia Lindl. in Quart. Journ. Soc. xix (1825) 7.

Locality: *S.W.*: In the higher regions (Stewart).

Distribution: Himalayan region.

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[1] This order should be inserted after the *Ficoideae*.

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PSAMMOGETON Edgew.

4 species.—W. Asia.

Psammogeton biternatum Edgew. in Trans. Linn. Soc. xx, 57.
Locality: *S.W.*: In the lower regions (Stewart).
Waziristan (Duthie's Collect. 15741)
Distribution: N.-W. India up to 3,000 ft., Sind, Baluchistan, Afghanistan, Persia.

DIPSACACEAE[1]

150 species.—Chiefly N. temperate regions, Old World, and tropical and S. Africa.

MORINA Tourn. ex L.

10 species.—E. Europe, Asia.

Morina Coulteriana Royle Ill. 245.
Locality: *S.W.*: Pre Ghal (Duthie's Collect. 15603 !).
Flowers: 17-5-1895 (Pre Ghal).
Distribution: Subalpine Himalaya 9,000-13,000 ft., from Kashmir to Garhwal, Kashgar.

Morina persica L. Sp. Pl. 39.—*M. Wallichiana* Royle Ill. 245, t. 55, fig. 1.
Locality: *S.W.*: Near Kaniguram brook (Stewart).
Distribution: W. Himalaya 7,000-9,000 ft., from Kashmir to Kumaon, Orient (from Persia to Greece).

DIPSACUS L.

12 species.—Mediterranean, Europe, Africa.

Dipsacus inermis Wall. in Roxb. Fl. Ind. ed. Carey & Wall. i, 367.
Locality: *S.W.*: Pre Ghal (Hay).
Distribution: Temperate Himalaya 6,000-12,000 ft., from Kashmir to Bhutan.

SCABIOSA (Tourn.) L.

60 species.—Europe, Mediterranean.

Scabiosa Candolliana Wall. Cat. 430.
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15623 !).—Son Khel, 6,000-7,000 ft. (Duthie's Collect. 15760 !).
Flowers: 12-5-1895 (Son Khel); 19-5-1895 (Shakai).
Distribution: W. Himalaya, from Murree to Kumaon, 3,000-5,000 ft., Persian Baluchistan.

Scabiosa Olivieri Coult. Dips. 36, t. 2, fig. 10.
Locality: *Tank*: Near Tank (J. Williams !).—Shaur Hill near Tank (J. Williams !).
Flowers & Fruit: 1-5-1891 (Tank).
Distribution: Baluchistan, Punjab, Afghanistan, Persia, Mesopotamia, Arabia.

SUCCISA Neck.

4 species.—Mediterranean, Europe.

Succisa pratensis Moench. Meth. 489.—*Scabiosa succisa* L. Sp. Pl. 142.
Locality: Near Kaniguram brook (Stewart).
Distribution: Caucasus, Mediterranean, Europe, Siberia.

BORAGINACEAE[2]

1,800 species.—Tropical and temperate regions, especially Mediterranean.

EHRETIA L.

40 species.—Tropical, chiefly Old World.

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[1] This order should be inserted after the *Valerianaceae*.
[2] This order should be inserted after the *Gentianaceae*.

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Ehretita aspera Willd. Phyt. 4, t. 2, fig. 1; Roxb. Corom. Pl. t. 55.—*E. laevis* Roxb. *var. aspera* C. B. Clarke in Hook. f. Fl. Brit. Ind. iv, 142.
Locality: *N.W.*: Dwa Warkha (Stewart).
Flowers: May 1860.
Distribution: Punjab, W. Peninsula, Baluchistan, Afghanistan, Abyssinia.

HELIOTROPIUM (Tourn.) L.

220 species.—Tropical and temperate regions.

Heliotropium Eichwaldi Steud. Nom. ed. 2; Boiss. Fl. Or. iv, 131.
Vernacular name: Nil buti (Williams).
Locality: *N.W.*: Dwa Warkha (Stewart).
Tank: (J. Williams 7174 !).
Flowers: 4-5-1888 (Tank).
Distribution: Punjab, Kashmir, Rajputana Desert, Sind, Baluchistan, Orient, Central Asia, Australia.

Heliotropium undulatum Vahl Symb. Bot. i (1790) 13.—*H. ramosissimum* DC. Prod. ix, 536.
Vernacular name: Juthe musag (Williams).
Locality: *N.W.*: Razani (Stewart).
Tank: (J. Williams 7173 ! 7876 !).
Flowers: 9-5-1888 (Tank).
Fruit: 9-5-1888; 6-6-1888 (Tank).
Distribution: Tropical Asia, Orient, Mediterranean.

Heliotropium strigosum Willd. **var. brevifolia** C. B. Clarke in Hook. f. Fl. Brit. Ind. iv, 151.
Locality: *N.W.*: Razani (Stewart).
Tank: (J. Williams 7878 !).
Flowers: 25-6-1888 (Tank).
Distribution: Throughout India, Orient, Malaya, Australia.

Heliotropium cabulicum Bunge in Bull. Soc. Nat. Mosc. xlii (1869) i, 328.
Locality: Waziristan (Duthie's Collect 15800 !).
Distribution: Afghanistan.

HETEROCARYUM A. DC.

Heterocaryum echinophorum (Pallas) Brand in Engler's Pflanzenr. iv, 252 (1931) 95, **var. minimum** (Lehm.) Brand. l.c.—*Echinospermum minimum* Lehm. Pl. Asperifol. (1818) 126, n. 97; Clarke in Hook. f. Fl. Brit. Ind. iv (1883) 162.
Locality: *N.W.*: Near Datta Khel village, 4,600 ft. (B. & F. 1428 !).
Flowers & Fruit: 17-4-30 (Datta Khel).
Distribution: Punjab, Baluchistan, Afghanistan to Asia Minor, S. Russia, Soongaria.

ROCHELIA Reichb.

12 species.—Mediterranean to Australia.

Rochelia disperma (L.) Wettst. in Stapf Bot. Ergeb. Poluk's Reise (1885) 31.—*Lithospermum dispermum* L. Dec. pl. rar. hort. Upsal. t. 7; Sp. Pl. (1762) 191.—*R. stellulata* Rchb. Pl. Crit. ii (1823) t. 122; Rchb. in Flora (1824) 243.—*R. Bungei* Trautv. Contr. ad Fl. Turcom. no. 163, in Acta Hort. Petr. ix, 2, 462.—*R. incana* Kar. *et* Kir. Enum. pl. alt. no. 605; Ledeb. Fl. Ross. iii, 176; Boiss. Fl. Or. iv, 244.
Locality: Waziristan (Duthie's Collect. 15801 !).
S.W.: About Kaniguram (Stewart).
Flowers: September 1860 (Kaniguram).
Distribution: W. Himalaya, Baluchistan, Afghanistan, Orient, Europe, N. Africa, Soongaria.

ASPERUGO (Tourn.) L.

1 species.—Europe, Asia.

Asperugo procumbens L. Sp. Pl. (1753) 138; Ledeb. Fl. Ross. iii, 165; Boiss. Fl. Or. iv, 201.

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Locality: *N.W.*: Dariawasti (B. & F.).
Flowers: April 1930 (Dariawasti).
Distribution: Baluchistan, Afghanistan, Orient, Europe, N. Africa, Siberia, Altai Mts.

ANCHUSA L.

45 species.—Europe, N. Africa, W. Asia.

***Anchusa italica** Retz. Obs. i, 12.
Vernacular name: Alkanet.
Locality: *S.W.*: Razmak, in garden (B. & F. !).
Distribution: Mediterranean.

LYCOPSIS L.

3 species.—Europe, Asia.

Lycopsis arvensis L. Sp. Pl. 139.
Locality: *N.W.*: Khaisora (Stewart).
Distribution: Europe.

NONNEA Medic.

30 species.—Mediterranean.

Nonnea pulla Lam. *et* DC. Fl. Fr. iii, 626, in note.
Locality: *S.W.*: About Kaniguram (Stewart).

LITHOSPERMUM (Tourn.) L.

50 species.—Temperate regions.

Lithospermum arvense L. Sp. Pl. 132.
Locality: *S.W.*: To Razmak (Stewart).
Distribution: Europe, Orient.

ARNEBIA Forsk.

12 species.—Mediterranean, tropical Africa, Himalaya.

Arnebia Griffithii Boiss. Fl. Or. iv, 213.—*A. echioides* Hook. Bot. Mag. t. 4109.
Locality: Waziristan (Duthie's Collect. 15802 !).
S.W.: Palosina (Stewart).
Distribution: Sind, Punjab, Baluchistan, Afghanistan.
Note.—The flower has a very agreeable odour and a pretty yellow corolla, with 5 dark purple spots on it, which pious Musulmans assert to be the marks of Mahomed's fingers. Hence they call it Paighambari phul (Prophet's flower), and hold it in high favour (Stewart).

Arnebia sp.
Locality: *S.W.*: (Duthie's Collect. 15803 !).

ONOSMA L.

80 species.—Mediterranean, Himalayan.

Onosma echioides L. Sp. Pl. (1753) 196; Boiss. Fl. Or. iv, 181.
Locality: Waziristan (Duthie's Collect. 15801 ! 15805 ! 15806 !).
Distribution: Orient, Europe, Siberia, Altai Mts.

Onosma sp.
Locality: *S.W.*: About Palosina (Stewart).

SCROPHULARIACEAE[1]

2,600 species.—Cosmopolitan.

VERBASCUM Tourn. ex L.

210 species.—N. temperate regions of the Old World.

[1] This order should be inserted after the *Solanaceae*.

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Verbascum Thapsus L. Sp. Pl. 177.
Locality: *N.W.*: Razani (Stewart).
S.W.: Between Makin and Razmak (Stewart).
Flowers: April (Razani).
Distribution: Temperate Himalaya, 6,000-11,000 ft. from Kashmir to Bhutan westwards to the Atlantic.

LINARIA Tourn. ex Mill.

100 species.—N. hemisphere and S. America, chiefly extra-tropical.

Linaria bipartita Willd. Enum. Hort. Berol. (1809) 640.
Locality: *N.W.*: Miram Shah Fort, in garden (B. & F. 524 !).
Flowers: 28-3-30.
Distribution: Egypt, Algeria, Tunisia.

Linaria cabulica Benth. in DC. Prodr. x, 270.
Locality: *N.W.*: Razani (Stewart).
Distribution: Baluchistan, Afghanistan, Persia.

Linaria ramosissima Wall. Pl. As. Rar. ii, 43, t. 153.
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15692 !).—Razani (Stewart).
Tank: (J. Williams 7185 !).
Flowers: 30-4-1895 (Shakai); 4-5-1888 (Tank).
Distribution: Throughout India, Sind, Punjab, Baluchistan, Afghanistan, Burma, Ceylon.

SCHWEINFURTHIA A. Br.

3 species.—E. Africa to W. India.

Schweinfurthia sphaerocarpa A. Braun. in Monatsb. Akad. Wiss. Berlin (1866) 875.
Locality: *S.W.*: Jandola (F. 4128 !).
Fruit: 29-5-27 (Jandola).
Distribution: Sind, Baluchistan, Afghanistan.

SCROPHULARIA Tourn. ex L.

120 species.—N. temperate.

Scrophularia calycina Benth. Scroph. Ind. 18.
Locality: *S.W.*: Pre Ghal (Duthie's Collect. 15620 !).
Flowers: 17-5-1895 (Pre Ghal).
Distribution: W. Himalaya, from Kashmir to Kumaon, 6,000-12,000 ft.

Scrophularia scabiosæfolia Benth. in DC. Prod. x, 313.
Locality: Waziristan (Duthie's Collect. 15724 !).
Flowers: 26-4-1895.
Distribution: Punjab, W. Himalaya 10,000-12,000 ft., Afghanistan, Baluchistan.

Scrophularia cabulica Benth. in DC. Prodr. x, 316.
Locality: Waziristan (Duthie's Collect. 15724 !).
S.W.: In the upper regions (Stewart).
Flowers: September 1860.
Distribution: Afghanistan.

Scrophularia lucida L. Sp. Pl. 865.
Locality: *S.W.*: In the upper regions (Stewart; Duthie's Collect. 15646).
Distribution: W. Himalaya, from Kashmir to Kumaon, 8,000-13,000 ft. Afghanistan, westward to Italy.

Scrophularia sp.
Locality: Waziristan (Duthie's Collect. 15619).

HERPESTIS Gaertn. f.

50 species.—Tropical and subtropical, chiefly American.

Herpestis Monniera H.B.K. Nov. Gen. *et* Sp. ii, 366.

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Locality: *N.W.*: Razani (Stewart).
Tank (J. Williams 7184 !).
Flowers: 10-5-1888 (Tank); October 1860 (Razani).
Distribution: All warm countries.

WULFENIA Jacq.

3 species.—E. Mediterranean, Himalaya.

Wulfenia amherstiana Benth. Scroph. Ind. 46.
Locality: *N.W.*: Alexandra Ridge, on shaded banks, 7,500-7,700 ft., scarce (Lieut. Abbott 10 !).
Flowers: 1-9-32.
Distribution: W. Himalaya, from Kashmir to Kumaon 7,000-11,000 ft., Afghanistan.

VERONICA (Tourn.) L.

250 species.—Extratropical, many alpine.

Veronica Beccabunga L. Sp. Pl. (1753) 12.
Locality: *S.W.*: Kaniguram (Duthie's Collect. 15744 !).—In a pool on way to the Springs N. of Razmak, 6,750-7,300 ft. (B. & F. 1771 !).
Flowers: 25-4-30 (Razmak); 14-5-1895 (Kaniguram).
Distribution: W. Himalaya 9,000-12,000 ft., Afghanistan to Europe, N. Africa, N. Asia to Japan.

Veronica anagallis L. Sp. Pl. (1753) 12.
Locality: *N.W.*: Upper regions (Stewart).—Shakai, 6,000-7,000 ft. (Duthie's Collect. 15647 !).
Tank (J. Williams 7183 !).
Flowers: 30-4-1895 (Shakai); 17-5-1888 (Tank).
Distribution: N.-W. India up to 15,000 ft., to Bhutan, Bengal, Assam, Deccan, Asia, Europe, N. and S. Africa, N. America.

Veronica Peloponnesiaca Boiss. Fl. Or. iv, 462.
Locality: *N.W.*: Near Datta Khel village, on sand in dry water-course, 4,600 ft. (B. & F. 1451 !).
Flowers & Fruit: 17-4-30 (Datta Khel).
Distribution: Asia Minor.

Veronica biloba L. Mant. ii, 172.
Vernacular name: Babarkiae (Waziri).
Locality: *N.W.*: Along irrigation channel near Datta Khel village, 4,600 ft. (B. & F. 1427 !).
S.W.: 8 miles below Kaniguram valley, abundant in fields (Stewart).
Flowers: 17-4-30 (Datta Khel).
Distribution: W. Himalaya, from Kashmir to Kumaon, 5,000-15,000 ft., westward to Asia Minor, Soongaria.

Veronica agrestis L. Sp. Pl. 13.
Locality: *S.* & *N.W.* (Stewart).
Distribution: Punjab, W. Himalaya from Kashmir to Kumaon up to 9,000 ft., Orient, Europe, N. and E. Asia to Japan, China, N. Africa.

LEPTORHABDOS Schrenk.

4 species.—Central and S. Asia.

Leptorhabdos Benthamiana Walp. Rep. iii, 387.
Locality: *S.W.*: Pre Ghal (Hay).
Distribution: Temperate W. Himalaya, Kashmir to Kumaon, 5,000-11,000 ft., Afghanistan, Persia.

EUPHRASIA L.

100 species.—Extratropical.

Euphrasia officinalis L. Sp. Pl. 604.
Locality: *S.W.*: Pre Ghal (Hay).

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Distribution: Temperate Himalaya, 4,000-13,000 ft., Afghanistan, N. Persia to Europe, N., Central and E. Asia, N. America.

LAGOTIS J. Gaertn.

10 species.—N. and Central Asia.

Lagotis stolonifera Maxim in Bull. Acad. Petersb. xxvii (1881) 525.

See note by O. E. Schulz in Fedde Repert. xxxi (1933) 161-162.
Locality: Waziristan, close to the British Frontier (Hook. f. Fl. Brit. Ind. iv, 558) collected by Stewart.
Distribution: Asia Minor, Armenia to N. Persia.

Lagotis Blatteri O. E. Schulz in Fedde Repert. xxxi (1933) 161, t. cxxxiv.

Vernacular name: Ambreshia (Waziri).
Locality: *S.W.*: Razmak plain, forming dense patches on gravel and sand, 6,750 ft. (B. & F. 47 ! 47b !).
Flowers: 20-3-30.
Distribution: Endemic.

LABIATAE[1]

3,000 species.—Cosmopolitan, chiefly Mediterranean region.

PLECTRANTHUS L'Herit.

110 species.—Palaeotropics, E. Asia.

Plectranthus rugosus Wall. Pl. As. Rar. ii, 17.
Locality: *S.W.*: In the lower regions (Stewart).
Distribution: Himalayan region.

*LAVANDULA Tourn. ex L.

20 species.—Mediterranean to India.

***Lavandula Spica** Cav. Desc. 69.
Vernacular name: Lavender.
Locality: *S.W.*: Razmak, in garden (B. & F. !).
Distribution: Mediterranean region.

MENTHA (Tourn.) L.

25 species.—Old World.

Mentha viridis L. Sp. Pl. ed. ii, 804.—*M. sylvestris* L. *var. viridis* Boiss. Fl. Or. iv, 544.
Locality: Everywhere.
Distribution: Orient, Europe.

Mentha sylvestris L. **var. Royleana** Hook. f. in Fl. Brit. Ind. iv, 647.
Locality: *Tank* (J. Williams 7891 !).
Flowers: 29-5-1888 (Tank).

Mentha sylvestris L., **var. incana** Hook. f. in Fl. Brit. Ind. iv, 647.
Locality: *S.W.*: Near Kaniguram brook (Stewart).
Distribution of type: Temperate W. Himalaya, 4,000-12,000 ft., Afghanistan, Orient, Central Asia, temperate Europe.

LYCOPUS Tourn. ex L.

10 species.—N. temperate regions.

Lycopus europæus L. Sp. Pl. 21.
Locality: *N.W.*: Dwa Warkha (Stewart).
Distribution: W. Himalaya, 1,000-6,000 ft., Orient, Europe, N. and Central Asia.

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[1] This order should be inserted after the *Verbenaceae*.

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THYMUS Tourn. ex L.

33 species.—N. Old World.

Thymus syriacus Boiss. Diagn. ser. 1, xii, 47; Fl. Or. iv, 559.—*T. lanceolatus var. angustifolius* Benth. in DC. Prodr. xii, 203.
Locality: *S.W.*: On top of Shuidar, 10,990 ft. (F. 1519 !).
Flowers: 18-4-30 (Shuidar).
Distribution: Syria.

Thymus serpyllum L. Sp. Pl. 590.
Locality: *S.W.*: (Duthie's Collect. 15616 !).—Near Kaniguram, about 6,500 ft. (ex Stewart).—Near Kaniguram brook (ex Stewart).
Distribution: Europe, Asia and N. Africa.

ZIZIPHORA L.

12 species.—Mediterranean, Central Asia.

Ziziphora tenuior L. Sp. Pl. (1753) 31; Ledeb. Fl. Ross. iii, 370.
Vernacular name: Papar boti (Williams).
Locality: Waziristan (Duthie's Collect. 15664 !).
Tank: Shaur Hill (J. Williams !).
Flowers: 21-5-1891 (Tank).
Distribution: Baluchistan, Afghanistan, Orient, Asia Minor, Soongaria, Altai.

PEROVSKIA Karel.

4 species.—W. Asia.

Perovskia atriplicifolia Benth. in DC. Prodr. xii, 261.
Vernacular name: Sansobe.
Locality: *S.W.*: Pre Ghal (J. Williams 7901 !).
Flowers: 21-8-1888 (Pre Ghal).
Distribution: Baluchistan, Afghanistan.

SALVIA (Tourn.) L.

550 species.—Tropical and temperate regions.

Salvia santolinæfolia Boiss. Diagn. ser. 1, v, 13; Fl. Or. iv, 632.
Locality: *S.W.*: Barwand (Duthie's Collect. 15778 !).
Tank (J. Williams 7960 !).
Distribution: Sind, Afghanistan, Persia.

Salvia macrosiphon Boiss. Diagn. ser. 1, v, 11, **var. Kotschyi** Boiss. Fl. Or. iv, 615.
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15789 !).
Tank: Near Tank (J. Williams 7908 !).
Flowers: April; August.
Distribution of var.: Baluchistan, Afghanistan, Persia.

Salvia ægyptiaca L. Sp. Pl. (1753) 23.
Vernacular name: Rang boti (J. Williams); Paska (J. Williams).
Locality: *Tank*: Near Tank (J. Williams !).—Shaur Hill, near Tank (J. Williams !).
Flowers: May (Tank).
Distribution: Punjab, Afghanistan, Orient, N. Africa to the Cape Verde Islands.

Salvia lanata Roxb. Fl. Ind. i (1832) 146.
Locality: *N.W.*: Razani (Stewart).
Distribution: W. temperate Himalaya, Kashmir to Kumaon, 5,000-8,000 ft.

Salvia glutinosa L. Sp. Pl. 26.
Locality: *S.W.*: In the higher regions (Stewart).
Distribution: Temperate Himalaya, 6,000-9,000 ft., from Kashmir to Sikkim, Afghanistan, Orient, S. Europe.

Salvia ægyptiaca L. Sp. Pl. (1753) 23, **var. pumila** Hook. f. in Fl. Brit. Ind. 4 (1885) 656.—*S. pumila* Benth. Lab. 726.

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Locality: *N.W.*: Dwa Warkha (Stewart).
Flowers: May 1860 (Dwa Warkha).
Distribution: Punjab Plains, W. Peninsula, Sind, Rajputana Desert, Baluchistan, Afghanistan. Type in Orient, N. Africa, Cape Verde Islands.

Salvia macrosiphon Boiss. Diagn. ser. 1, v, 11.
Locality: *S.W.*: Pre Ghal (J. Williams 7894 !).
Distribution: Persia.
Uses: Poultice for gangrene (J. Williams).

NEPETA Riv. ex L.

150 species.—N. hemisphere.

Nepeta spicata Benth. in Wall. Pl. As. Rar. i, 64.
Locality: *S.W.*: Pre Ghal (Hay, J. Williams 7898 !).
Flowers: 17-8-1885; September (Pre Ghal).
Distribution: W. temperate Himalaya, from Kashmir to Kumaon, 6,000-12,000 ft., Afghanistan.

Nepeta raphanorrhiza Benth. Lab. 734.
Locality: Waziristan (J. Williams 9173 !).
S.W.: Near Kaniguram (Stewart).
Distribution: W. temperate Himalaya, 5,000-12,000 ft., Afghanistan.

Nepeta distans Benth. in Hook. Bot. Misc. iii (1833) 378; Lab. 475.—*N. mollis* Benth. Lab. 731.
Locality: *S.W.* (J. Williams 7909 !).
Flowers: 10-8-1888 (S.W.).
Distribution: W. Temperate Himalaya, 8,000-9,000 ft., Punjab Himalaya.

Nepeta juncea Benth. in DC. Prodr. xii, 379; Boiss. Fl. Or. iv, 651.
Locality: *N.W.*: In bed of Khunai River below Razani, 5,050 ft. (B. & F. 1125 !).
S.W.: Barwand, 6,000-7,000 ft. (Duthie's Collect. 15642 !).—Wana, 4,500 ft. (Duthie's Collect. 15670 !).
Flowers: 28-4-1895 (Barwand); 12-4-30 (Razani); 5-5-1895 (Wana).
Distribution: Baluchistan, Afghanistan.

LALLEMANTIA Fisch. & Mey.

4 species.—W. Asia.

Lallemantia Royleana Benth. in DC. Prodr. xii, 404.
Locality: *N.W.*: Razani (Stewart).
S.W.: Kaniguram (Stewart).—Barwand, 4,000 ft. (Duthie's Collect. 15705 ! 15709 !).
Flowers: April 1895 (Barwand).
Distribution: Punjab, Afghanistan, Persia, Turkestan.

SCUTELLARIA Riv. ex L.

200 species.—Cosmopolitan, except S. Africa.

Scutellaria linearis Benth. in Wall. Pl. As. Rar. i, 66.
Locality: *S.W.*: Near Kaniguram, about 6,500 ft. (Stewart), near Kaniguram brook (Stewart).
Flowers: September 1860 (Kaniguram).
Distribution: Temperate W. Himalaya, from Kashmir to Kumaon, 3,000-8,000 ft., Afghanistan.

Scutellaria multicaulis Boiss. Diagn. n. ser. 1, vii, 61; Fl. Or. iv, 685.
Vernacular name: Sandor boti.
Locality: *Tank*: Near Tank, Shaur Hill (J. Williams !).
Flowers: 1-5-9 (Tank).
Distribution: Afghanistan, Persia, Turkestan.

Scutellaria prostrata Benth. Lab. 733.
Locality: *N.W.*: Shakai, 6,000-7,000 ft. (Duthie's Collect. 15652 !).
S.W.: Pre Ghal (Duthie's Collect. 15597 !).

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Flowers: 30-4-1895 (Shakai); 19-5-1895 (Pre Ghal).
Distribution: W. Himalaya, from Kashmir to Kumaon, 8,000-14,000 ft.

Scutellaria sp.
Locality: *S.W.*: In the upper regions (Stewart).

STACHYS (Tourn.) L.

200 species.—Cosmopolitan except Australia.

Stachys parviflora Benth. in DC. Prodr. xii, 490.
Locality: *S.W.*: Wana, 4,000-5,000 ft. (Duthie's Collect. 15657 !).—Pre Ghal (J. Williams 7895 !).
Flowers: 5-8-1888 (Pre Ghal); 2-5-1895 (Wana).
Distribution: Punjab, Afghanistan.

Stachys floccosa Benth. Lab. 739.
Locality: *S.W.*: Pre Ghal (J. Williams 7903 !).
Flowers: 17-8-1888 (Pre Ghal).
Distribution: W. temperate Himalaya, 5,000-6,000 ft., Afghanistan.

MARRUBIUM Tourn. ex L.

30 species.—Europe, N. Africa, temperate Asia.

Marrubium vulgare L. Sp. Pl. (1753) 583.
Locality: *N.W.*: Razmak (Stewart).—Shakai, 6,000-7,000 ft. (Duthie's Collect. 15691 !).
S.W.: Wana, 4,500 ft. (Duthie's Collect. 15655 !).—Pre Ghal (J. Williams 7906 !).
Flowers: 30-4-1895 (Shakai); 2-5-1895 (Wana); 1-8-1888 (Pre Ghal).
Distribution: Baluchistan, Orient, Europe, N. and tropical Africa.

MOLUCCELLA L.

2 species.—Mediterranean.

Moluccella otostegioides Prain in. Journ. As. Soc. Beng. lix (1891) ii, 311.
Locality: *S.W.*: Wana, 4,500 ft. (Duthie's Collect. 15788 !).—Shakai, 6,000-7,000 ft. (Duthie's Collect. 15643 !).
Flowers: 30-4-1895 (Shakai); 8-5-1895 (Wana).
Distribution: India.

LEONURUS L.

8 species.—Europe, Asia and tropical regions.

Leonurus sibiricus L. Sp. Pl. 584.
Locality: *S.W.*: Pre Ghal (Hay).
Distribution: Siberia, China.

PHLOMIS L.

70 species.—N. palaeotemperate.

Phlomis Stewartii Hook. f. in Fl. Brit. Ind. iv, 692.
Vernacular name: Chambar-boti (Williams).
Locality: *S.W.*: Wana (Duthie's Collect. 15633 ! 15677 !).
Tank: Near Shaur Hill (J. Williams !).
Flowers: 7-5-1895 (Wana); 21-5-1891 (Tank).
Distribution: Punjab, Salt Range, 2,500-4,500 ft.

Phlomis sp.
Locality: *S.W.*: In the higher regions (Stewart).

EREMOSTACHYS Bunge.

40 species.—Middle and W. Asia.

Eremostachys acanthocalyx Boiss. Diagn. 2, iv, 49.—*E. laciniata* Aitchis. Cat. Punj. Pl. & Scinde 118 (*non* Bunge).

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Locality: *N.W.*: Dwa Warkha (Stewart).
S.W.: Above Palosina (Stewart).
Distribution: W. Punjab, Baluchistan, Afghanistan.

TEUCRIUM (Tourn.) L.

100 species.—Cosmopolitan.

Teucrium Stocksianum Boiss. Diagn. ser. 2, iv, 58.
Vernacular name: Kastorai.
Locality: *S.W.*: Wana, 4,500 ft. (Duthie's Collect. 15678 !).—Barwand 4,000 ft. (Duthie's Collect. 15700 !).
Tank: Shaur Hill (J. Williams !).
Flowers: 17-4-1895 (Barwand); 7-5-1895 (Wana); 31-5-1891 (Tank).
Distribution: Baluchistan.

AJUGA L.

30 species.—Palaeotemperate.

Ajuga parviflora Benth. in Wall. Pl. As. Rar. i, 59.
Locality: Near Kaniguram, about 6,500 ft. (Stewart).
Distribution: W. Himalaya, from Kashmir to Kumaon, 2,000-7,000 ft., Afghanistan.

Ajuga bracteosa Wall. Cat. 2032.
Locality: *N.W.*: Shakai (Duthie's Collect. 15649 !).
Flowers: 30-4-1895 (Shakai).
Distribution: W. Himalaya, from Kashmir to Nepal, 1,000-7,000 ft., Afghanistan, Abyssinia, China, Japan.

[Certain Orders have been omitted, but these will appear when they have been worked out by the specialist to whom they have been submitted].

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THE INDIAN CADDIS-FLIES (*TRICHOPTERA*)

BY

MARTIN E. MOSELY, F.R.E.S.

PART II.

(*With 8 text-figures*).

(*Continued from p. 664 of volume* XXXVI).

CLASSIFICATION.

In my last article I dealt with the life-history of the Caddis-flies and the methods to be adopted for their collection and preservation. We have now to consider how to name the insects we may have captured.

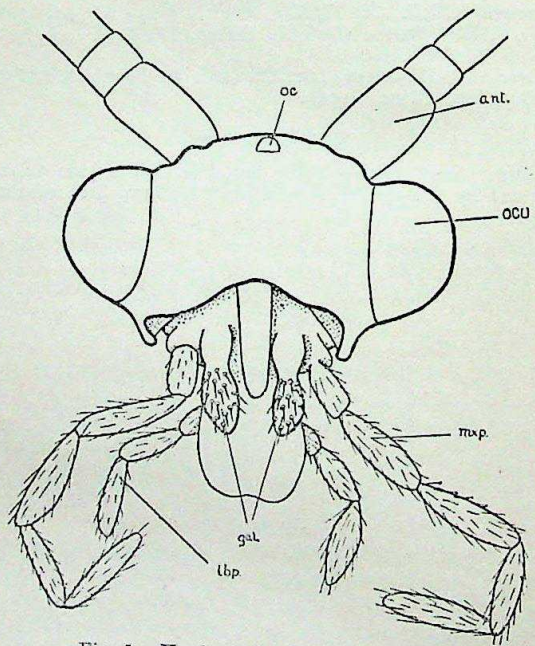

Fig. 1.—Head of *Anabolia laevis* McL.—
oc, ocellus; *ant*, antenna; *ocu*, oculus; *mxp*, maxillary palpus; *gal*, galea; *lbp*, labial palpus.—after Packard.

Before attempting this task, it is necessary that we should have a certain amount of knowledge as to the structures of the head particularly the mouth-parts, the neuration of the wings, the form and construction of the genitalia, etc.

Parts of importance to be recognised in the head are the *ocelli* or simple eyes, three in number when present, the form of the

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basal joints of the antennae and above all, the structure of the maxillary palpi.

I have already pointed out that one of the main differences between the *Trichoptera* and the *Lepidoptera* is to be found in the form of two processes of the mouth known as the *galea* and that

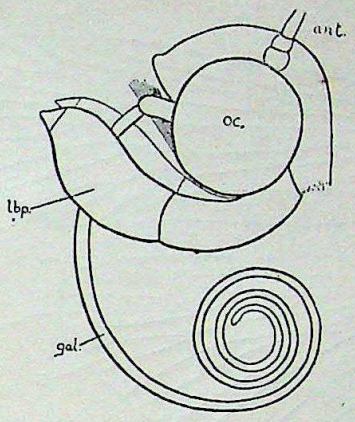

Fig. 2.—Head of a *Lepidopteron*, lettering as in figure 1.

in the latter Order, these processes are enormously produced and form the long sucking proboscis. I will therefore call the attention of my readers to the *galea* (gal.) indicated in figs. 1 and 2 which are diagrammatic representations of the heads of a Trichopteron and a Lepidopteron respectively. Other parts of importance are indicated in the legends accompanying the figures.

With regard to the wing neuration I am adopting the nomenclature used by Ulmer in the *Genera Insectorum*, based on the Comstock and Needham notation rather than that of McLachlan, as Ulmer's work has a more general application than McLachlan's Monograph of purely European species.

Many of the genera have been erected on characters of neuration so that it is extremely important for the student to make himself thoroughly conversant with the general pattern and the names of the various cells and nervures. They will be referred to again and again and a little time spent in mastering them will be amply repaid when the practical work is taken in hand.

I give here the figure of the wings of a *Hydropsyche* species in which the neuration is practically complete.

The nervure forming the anterior margin of the wing is termed the *costa* (C); beneath this is the *sub-costa* (Sc) which sometimes continues parallel with the *costa* almost for its entire length but generally joins it before the extreme apex of the wing; the *sub-costa* is usually connected to the *costa* by one or more cross-veins, rarely more than two. Arising near the base of the *sub-costa* is a vein which soon forks in two branches; the upper of these branches is the *radius* (R) and the lower, the *radial-sector* (Rs). The *radius* generally flows directly into the *costa;* in *Hydropsyche* and many

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other genera, the *radial-sector* is forked and each branch of the fork is itself forked thus forming *apical forks* 1 and 2. There is frequently a cross-vein uniting the two branches beyond the first furcation and this encloses a space known as the *discoidal cell* (dc). Below the *radial sector*, proceeding from the base of the wing, we

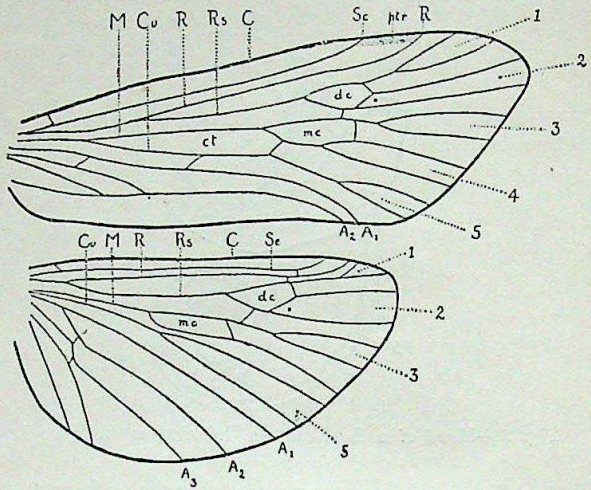

Fig. 3.—Wings of *Hydropsyche* species.—
C, costa; *Sc*, sub-costa; *ptr*, pterostigma; *R*, radius; *Rs*, radial-sector; *dc*, discoidal cell; *M*, media; *mc*, median cell; *Cu*, cubitus; *ct*, cellular thyridii; A_1, A_2, A_3, anal veins; 1, 2, 3, 4 and 5 apical forks.

find another nervure which forks almost immediately to make the *media* (M) the upper, and the *cubitus* (Cu) the lower of the two branches. Following the course of the *media*, we find that it again branches and each branch terminates in a fork, the upper being the *apical fork* 3 and the lower, *apical fork* 4. Here again we find a cross-vein close to the first furcation of the *media* enclosing what is known as the *median cell* (mc); the *media* is generally united to the *radial-sector* by a cross-vein. Tracing the *cubitus*, we find that it forks before meeting the margin of the wing to make *apical fork* 5. In the anterior wing, there is a cross-vein uniting the *media* to the *cubitus* in the region of the *median cell* and this encloses an area known as the *cellular thyridii* (ct). The remaining veins are called *anal veins* (A_1, A_2, A_3) and sometimes *anal vein* 2 is seen to run parallel with the basal margin of the wing when it is known also as the *post-costa*.

In the posterior wing, almost invariably we find the lower fork of the *media* unbranched at the margin of the wing so that fork 4 is wanting. The only known exception to this is found in the genus *Helicopsyche*.

Some allusion will be made to the apical sectors. These are the nervures meeting the apical margin of the wing between the upper nervure of fork 1 (when present) and the lower nervure of fork 5 inclusive.

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If we consider the spaces between the nervures, we find, beginning with fork 1, ten cells towards the margin in the anterior and eight in the posterior wing. A dark spot may be observed at the base of fork 2 in each wing. A small area of the membrane at the costal margin between the termination of the sub-costa and the radius is frequently different in texture to the rest of the wing and perhaps darker in colour. This is termed the *pterostigma* (ptr.).

These are the main features that we have to consider. We shall find that in most of the genera some modification of this neuration has taken place and the *apical forks*, which are of extreme importance in the classification, are frequently reduced and sometimes rather hard to recognise, giving cause unfortunately to much theorising amongst various authors.

We have now to consider the abdomen with the all-important structures of the genitalia. In the *Trichoptera* there are nine segments. Dorsally, eight may easily be defined. The first, i.e. the one nearest the thorax, is somewhat in the form of a plate and when the abdomen is detached this plate is seen to have no corre-

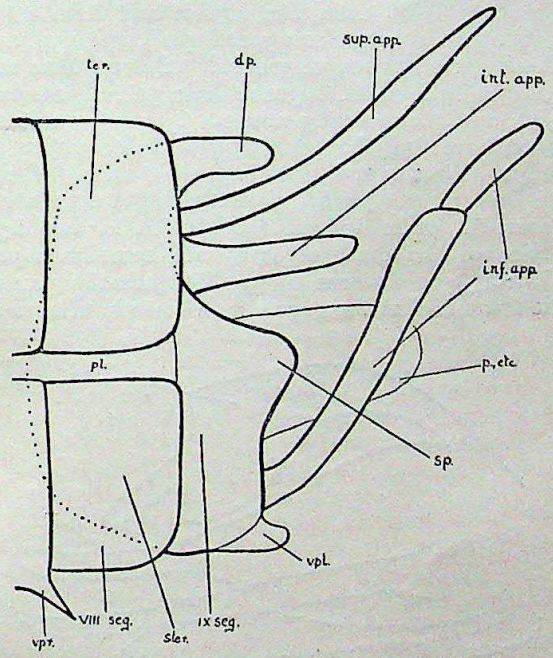

Fig. 4.—Diagrammatic genitalia of a *Trichopteron*.
ter, tergite; *dp*, dorsal plate; *sup. app.*, superior appendage; *int. app.*, intermediate appendage; *inf. app.*, inferior appendage; *p.*, penis; *sp.*, side-piece; *vpl.*, ventral plate; *ster.*, sternite; *pl.*, pleurite; *vpr.*, ventral process.

sponding ventral segment beneath it. If there is such a segment it is so reduced as to be practically non-existing. We must therefore call the first visible ventral segment No. 2 in order that it may correspond with its dorsal fellow.

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The second to the eighth segments inclusive are formed of chitinous plates, the dorsal often rather more strongly chitinised than the ventral and generally darker in colour. These plates are joined at the sides, dorsal to ventral, by thin membranes. The dorsal segments are termed *tergites* (ter.), the ventral, *sternites* (ster.), and the thin lateral membranes, *pleurites* (pl.).

The ninth segment is generally partly withdrawn into the eighth and is constructed after a different fashion. Instead of dorsal and ventral plates joined by lateral membranes, we find a strongly chitinised hoop or ring without any lateral divisions. To this segment are attached the parts of the genitalia which, by their variations, give the main characters for the separation of the species.

I give here a diagrammatic figure of the genitalia of an imaginary caddis-fly which is supposed to be equipped with all the parts which compose these structures, a condition which probably does not occur in any individual fly.

Projecting from the centre of the dorsal margin we may have a dorsal plate (dp.) On each side of this and from a little below it there arises a pair of superior appendages (sup. app.), sometimes long and slender, sometimes very short. Below these and still towards the upper half of the segment is a pair of intermediate appendages (int. app.) of varying shape. Then, towards the centre of the segment, we find the penis (p.) with its upper (upc.) and lower (lpc) penis-covers and sheaths (psh), all attached together towards the base of the penis. I am giving a separate outline of these processes in order to avoid confusion in the figure. The lateral margins of the ninth segment are sometimes produced in what are known as side pieces (sp.). Beneath the penis and arising from the lower half of the segment, we nearly always find a pair

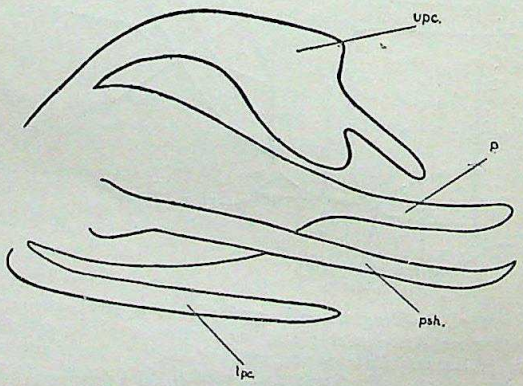

Fig. 5.—Penis and its processes.—
upc, upper penis-cover; *p.*, penis; *psh.*, penis-sheath; *lpc.*, lower penis-cover.

of inferior appendages (inf. app.), frequently two-jointed. Sometimes the lower margin of the segment is produced at its centre in the same way as the upper, to form a ventral plate (vpl.). There

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is frequently a spur, sometimes more than one, termed a ventral process (vpr.) arising from the centre of the margin of one or more of the terminal ventral segments.

It generally happens that some of the above parts are missing and it is difficult sometimes to homologise the processes we do find with this diagrammatic conception of a complete genitalia. It follows, therefore, that in describing new species, it is of the utmost importance to give full figures of these parts rather than to depend on a verbal description which may not invariably be interpreted as intended by the author.

Now as to the legs, these are long and slender, often with the tibiae and tarsi of the median legs dilated in the female sex, sometimes in both, and carrying not only numerous short spines but spurs as well though these may be absent in one or other of the legs, never in all three. These spurs are of considerable importance in classification and at one time were considered to furnish good and sufficient characters for the separation of the genera. With a more advanced knowledge of the Order, the importance of the spurs has been somewhat diminished as a generic character so that we may find species with varying spur-formulae placed in the same genus. When we talk of the spurs being let us say 3, 4, 4 or 0, 2, 3, we mean that the anterior leg carries 3 or 0

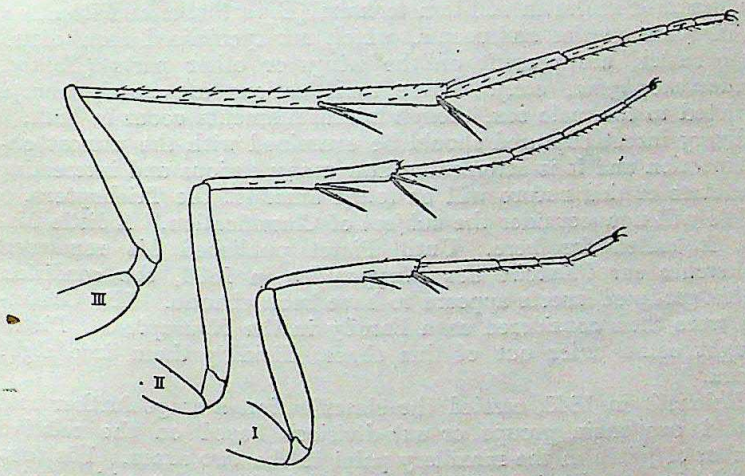

Fig. 6.—Legs of *Rhyacophila* species.—
(1) anterior leg; (2) median leg; (3) posterior leg.

spurs, the median 4 or 2 and the posterior 4 or 3. As the spurs are apt to meet with accidents and get rubbed off, we must not attach undue importance to their presence or absence. Generally, though, a socket can be made out where a spur has been lost. Spurs are usually longer and paler in colour than the spines.

Finally we occasionally find some modification of structure in various parts which may furnish a clue to the identity of a capture. In the head there are sometimes specialised structures such as scent-organs. These may be situated at the back of the head as

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in *Hydroptila*, or at the base of the antennae as in *Triaenodella* or even in the maxillary palpi as in *Sericostoma* and *Goëra*. Sometimes we find long filaments attached to the fourth ventral segment at the lateral margins as in *Diplectronella* and other genera. Or we may find a fold or a callosity at the base of the anterior wing as occurs in *Glossosoma* and *Beraea*. In *Drusus* and the allied

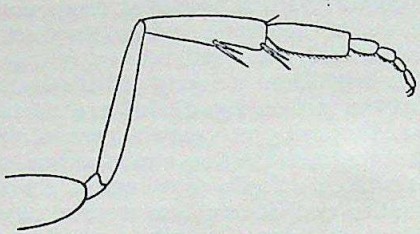

Fig. 7.—Median leg of ♀ *Glossosoma* species.

genera, there is a long pencil of hairs situated in a fold towards the base of the posterior wing. Sometimes the wings are clothed with modified scales in addition to hairs (*Dinarthrum* and its allies) and in some species androconia, which are specialised scent-distributing scales, are present on the wings or other parts (*Beraea*, *Pseudostenophylax*, etc.). These modifications are nearly always restricted to the male sex, though lateral filaments occur in both.

Every insect captured should be examined with the utmost circumspection and it is astonishing how many curious and interesting characters of this nature will be found amongst the Trichoptera.

We will now consider the subject of Classification. A little history is called for here. Until Pictet published his renowned *Recherches sur l'histoire des Phryganides* in 1834, the condition of this group of insects appears to have been chaotic. The Caddisflies were then considered as a Family in the *Neuroptera*. Pictet brought some order out of this chaos, dividing them into eight genera.

Kolenati, in 1848, carried the classification a stage further and created two main groups or sub-divisions based on the relative number of joints in the maxillary palpi in the two sexes. His first sub-division, the INAEQUIPALPIA, contains all the groups with species in which the number of joints are unequal in the two sexes, fewer in the male than in the female. In the second sub-division, the AEQUIPALPIA, are placed the groups whose species have an equal number of joints in both sexes. This was indeed a great step forward and his sub-divisions were retained both by McLachlan in his *Monographic Revision and Synopsis of the Trichoptera of the European Fauna* 1884 and also by Ulmer in the fascicule of the *Genera Insectorum* dealing with the *Trichoptera* 1907. It may be that this broad sub-division is artificial and perhaps not in true accord with the relationship of the various groups, now regarded as families since the *Trichoptera* have been elevated to an Order. Other

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Trichopterists, notably Mr. A. B. Martynov in his *Practical Entomology* published in Russian in 1924, have not accepted this grouping on the ground that it disregards more important natural affinities. Possibly they may have reason. Nevertheless for the student, Kolenati's division has the merit of extreme simplicity whilst Martynov depends for the division of the *Trichoptera* into his sub-orders the ANNULIPALPIA and the INTEGRIPALPIA partly on the form and habits of the larvae which, in India at any rate are practically unknown, and partly on structures in the adult insect, some of which are very obscure. Moreover, the characters selected

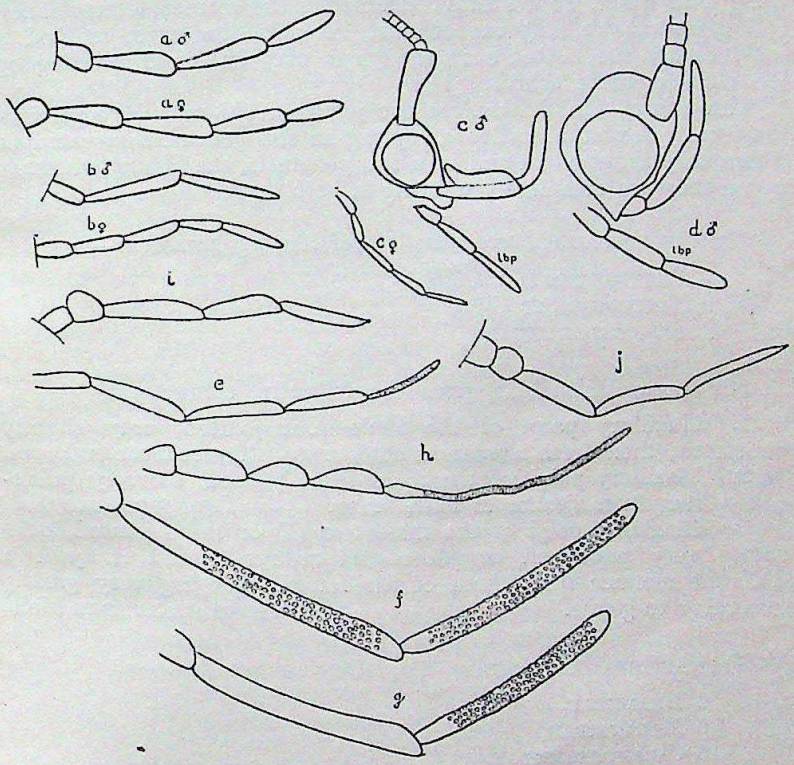

Fig. 8.—Forms of maxillary palpi.—
a ♂, *a* ♀ *Phryganeidae; b* ♂, *b* ♀ *Limnophilidae; c* ♂, *c* ♀ (*Lepidostoma*); *d* ♂ (*Micrasema*) *Sericostomatidae; e, Leptoceridae; f* and *g*, enlarged figures of terminal joints of the max. palpi of *f, Leptocerus annulicornis* and *g, Leptocerus albifrons; h, Hydropsychidae; i, Rhyacophilidae; j, Hydroptilidae.*

for the sub-orders are not invariably present in the Families they contain. To give an instance, the larvae in the ANNULIPALPIA are supposed to be all of non-case making habits. Yet the sub-order includes the HYDROPTILIDAE and the RHYACOPHILIDAE, the former *all* making cases as far as is at present known and certainly some of the latter such as *Agapetus* and its allied genera. Again, in the

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INTEGRIPALPIA, the discoidal cell is given as being 'rather long in the forewing'. But the sub-order includes the BERAEIDAE and the MOLANNIDAE in which the discoidal cell is entirely wanting and in some of the SERICOSTOMATIDAE, a family which is also included in this sub-order, the discoidal cell is very short, *Micrasema* for instance. Nevertheless, in spite of these objections his sub-orders are very natural and, for the advanced student, no doubt practicable. But, after due consideration I am convinced that, for the beginner it is better to retain Kolenati's old divisions and to follow the system adopted by Ulmer in the *Genera Insectorum*. The main thing with which we are here concerned is the correct determination of the insects we may capture and, for this, the easier method is undoubtedly the better even though it may be found wanting by the ultra-scientific school.

Throughout the *Trichoptera* the joints of the maxillary palpi in the female sex number five excepting in the genus *Anisocentropus* where they number six and in a few genera in the HYDROPSYCHIDAE where they are completely wanting in both sexes.

The INAEQUIPALPIA contains the following families:—

1 PHRYGANEIDAE.
2 LIMNOPHILIDAE.
3 SERICOSTOMATIDAE.

For these, McLachlan gives the following characters:—

1. Maxillary palpi of the male four jointed, only slightly pubescent, their form similar in both sexes. PHRYGANEIDAE Burm.
2. Maxillary palpi of the male three jointed, scarcely pubescent, their form similar in both sexes. LIMNOPHILIDAE Kol.
3. Maxillary palpi of the male two (?) or three jointed, ordinarily very pubescent or pilose and always formed in quite a different manner from those of the female, varying very greatly according to genus. SERICOSTOMATIDAE McL.

The AEQUIPALPIA contains the following families:—

4 BERAEIDAE.
5 MOLANNIDAE.
6 CALAMOCERATIDAE.
7 ODONTOCERIDAE.
8 LEPTOCERIDAE.
9 HYDROPSYCHIDAE.
10 POLYCENTROPIDAE.
11 PSYCHOMYIDAE.
12 PHILOPOTAMIDAE.
13 RHYACOPHILIDAE.
14 HYDROPTILIDAE.

As there are so many families in the AEQUIPALPIA, I will give here, for convenience, a modification of Ulmer's table in the *Genera Insectorum*, reserving the consideration of the family characters in greater detail until later.

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AEQUIPALPIA.

Maxillary palpi five-jointed in both sexes excepting in some of the HYDROPSYCHIDAE genera in which they are entirely wanting in both male and female and also in the genus *Anisocentropus* where, in the female, the joints number six.

1. Insects very minute, very strongly pubescent; the wings with numerous erect hairs, fringes very long, those of the posterior wing longer than the greatest breadth of the wing; antennae short and stout, shorter in the ♀ than in the ♂, terminal joint of the maxillary palpus simple. 14 HYDROPTILIDAE Pict.

—Insects rarely small, generally medium sized or large, anterior wings without thick erect hairs, or at the most such hairs are thinly sprinkled; fringes of the posterior wing not as long as the breadth of the wing; antennae as long as or longer than the anterior wing, only very occasionally shorter. 2

2. Terminal joint of the maxillary palpi articulated (except in *Hyalopsychodes*), generally much longer than all the other joints together. 3

—Terminal joint not articulated, sometimes flexible, only a little, or not longer than the other joints together. 6

3. *Ocelli* present. 12 PHILOPOTAMIDAE Walleng.

—*Ocelli* absent. 4

4. Anterior tibiae generally with three spurs (in some species of *Ecnomus* only two). 10 POLYCENTROPIDAE Ulmer.

—Anterior tibiae with fewer than three spurs. 5

5. Fork 1 in the anterior wing present. 9 HYDROPSYCHIDAE Curtis.

—Fork 1 in the anterior wing (and in the posterior wing) absent. 11 PSYCHOMYIDAE Kol.

6. *Ocelli* present. 13 RHYACOPHILIDAE Stephens.

—*Ocelli* absent. 7

7. Median cell in the anterior wing closed. 6 CALAMOCERATIDAE Ulmer.

—Median cell in the anterior wing absent. 8

8. Discoidal cell in the anterior (and posterior) wing absent. 9

—Discoidal cell in the anterior wing present. 10

9. Spurs 2 4 4. 5 MOLANNIDAE Walleng.

—Spurs 2 2 4. 4 BERAEIDAE Walleng.

10. Fork 2 in the anterior wing present. 7 ODONTOCERIDAE Walleng.

—Fork 2 in the anterior wing generally absent (in *Triaenodes* and *Symphitoneuria* the apparent fork 2 is probably a false fork). 8 LEPTOCERIDAE Leach.

Many of the above families have been again split up into sub-families. I will deal with these when later I am discussing their individual composition.

(*To be continued*).

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SOME OBSERVATIONS ON THE GENUS *ARISAEMA* ON THE NILGIRI HILLS, SOUTH INDIA

BY

EDWARD BARNES, B.Sc. (Lond.).

(*With 2 plates*).

The South Indian species of this interesting genus do not appear to have received the attention that they deserve. Of the five species of *Arisaema* included in the Flora of the Presidency of Madras (Part IX by Mr. C. E. C. Fischer, published in 1931) *A. pulchrum* is known from only one specimen and *A. Wightii* until recently was known only from material 'all in a more or less dilapidated condition, hardly permitting a precise conception' (Fischer); and even the two very common species, *A. tortuosum*, Schott, and *A. Leschenaultii*, Blume, have received little attention in the field for many years. The collections made by the writer have resulted in the founding of four new species, descriptions of which have recently appeared or are in process of publication (*A. Barnesii*, Fischer, *A. translucens*, Fischer, *A. tylophorum*, Fischer, Kew Bull. 1933, 339, and *A. convolutum*, Fischer, in the press).[1] The observations recorded below include some additional information about these new species as well as some further obervations on several of the older ones.

DISTRIBUTION

In South India this genus is almost entirely confined to the higher hills.

On the Nilgiris by far the commonest species is *Arisaema Leschenaultii*, Blume. It is usually found in sholas, and there are very few sholas above 6,000 ft. in which it is not to be found. It generally grows on the ground in leaf-mould. A number of sholas on the Wenlock Downs show a remarkable absence of undergrowth; in these sholas *A. Leschenaultii* becomes epiphytic. An example that may be quoted is the shola on the side of Anikalbetta ('Staircase'), where at least 90 per cent of the plants of this species were found to be growing on moss-covered branches, in forks or on outstanding roots of trees. On some of the highest hills, such as Pichalbetta, its characteristic place of occurrence is on the margins of sholas or under the shade of bushes. In wet places it is not uncommon in the open amongst grass or in cracks between rocks. The spathe of *A. Leschenaultii* varies in colour from light green or yellowish-green striped with white to dark crimson-purple with lighter stripes. Generally those plants that grow in dense shade or in wet situations have spathes that are green and white while those that grow in dry or exposed places tend to have more or less purple spathes.

A. tortuosum, Schott, appears to be the most widely distributed species of this genus in India. It is found in dryer places and down to lower levels than the other species in the Nilgiris.

[1] Now published Kew Bull. 1934, 167.

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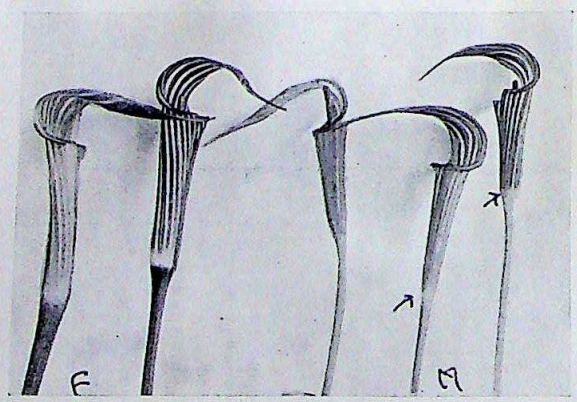
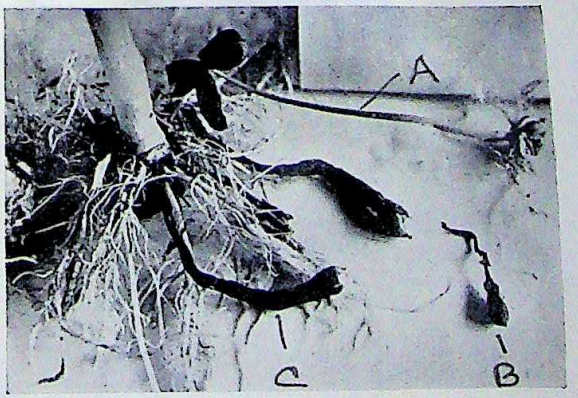
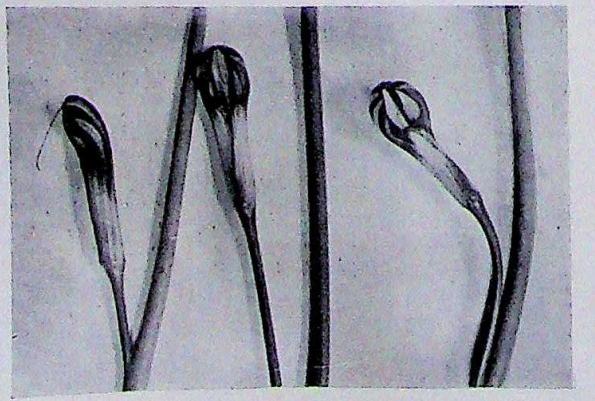


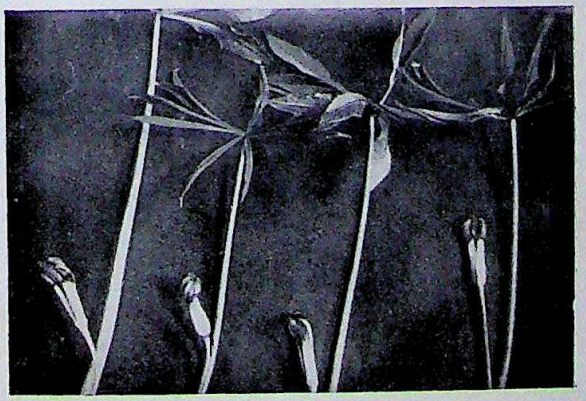
1. *Arisaema Leschenaultii* Blume.
Female and male inflorescences.



2. *Arisaema Leschenaultii* Blume.
A. Seedling. B. Detached corm.
C. Undetached corm.



3. *Arisaema translucens* Fischer.



4. *Arisaema translucens* Fischer.

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It is not found much above 6,000 ft. except the non-typical form with five leaflets, which grows up to about 8,000 ft. It often grows in the open and is common on road sides and on the margins of clearings in sholas on the ghats. The colour of the spathe and appendage of the spadix varies from green or purplish-green to almost black.

A. Barnesii, Fischer, is not uncommon between 5,000 ft. and 6,500 ft. in sholas, but does not appear to occur at higher levels. It has been found in Longwood Shola, Kotagiri, near Pykara Falls, at Neduvattam and in Thiashola. It has been found only in the ground. The colour of the spathe varies from green with white stripes to dark purple with white stripes.

A. convolutum, Fischer, has been found to be common in several sholas above Parson's Valley, and a few specimens have been seen in Governor Shola near Ootacamund and on the sides of Emerald Valley. It appears to require a wet climate and a fairly high altitude (7,500 ft.). It grows both in leaf-mould on the ground and on moss-covered branches or roots of trees.

A. translucens, Fischer, has been found only in Thiashola and its neighbourhood. It is found amongst undergrowth in dry sholas down to about 5,500 ft. It was also found growing in cracks in rocks in a dry shola.

A. tylophorum, Fischer, has been found at Neduvattam, at the upper end of the Ouchterlony Valley and in Thiashola (6,000-7,000 ft.). It grows in the ground and is usually found on the edges or in the more open parts of sholas.

Except the non-typical form of *A. tortuosum* which flowers in March and April, all the above mentioned species of *Arisaema* flower in May and June on the Nilgiris.

Number of Leaflets

Below are given the results of counts made of all plants seen at the times and places mentioned. The number in the brackets is the number of leaflets, and the number before the bracket is the number of plants found to have that number of leaflets.

A. Leschenaultii. Longwood Shola. 27-5-32.

Each plant had one leaf.
Males: 2 (5), 5 (6), 96 (7), 80 (8), 50 (9), 16 (10), 4 (11).
Females: 3 (8), 6 (9), 12 (10), 4 (11), 3 (12).
Number of leaves with odd number of leaflets: 168.
Number of leaves with even number of leaflets: 119.

A. tortuosum, typical form. Banagudi Shola. 18-6-32.

Each plant had two leaves.
Monoecious: 2 (7), 5 (8), 32 (9), 4 (10), 4 (11), 1 (12).
Males: 5 (5), 4 (6), 37 (7), 6 (8).
Number of leaves with odd number of leaflets: 78.
Number of leaves with even number of leaflets: 20.

Early flowering, non-typical form. Longwood Shola and Dodabetta. April 1933.

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Each plant had two leaves with five leaflets.

This plant differs from the normal form in having pedatisect leaves always having five leaflets, in occurring at higher altitudes, in flowering in March and April, and in the spathe becoming black on withering, and not yellow.

A. Barnesii, typical form. Thiashola at lower altitudes. 12-6-33.

Each plant had one leaf.
Males: 23 (5), 5 (6), 13 (7), 8 (8), 2 (9).
Females: 1 (7), 3 (8), 1 (10).
Non-typical form. Thiashola at higher altitudes. 12-6-33.
Males: 3 (5), 10 (7), 1 (8).
Females: 2 (7), 1 (9).

This plant differs from the typical form in the markings on the spathe, notably in the presence of a white patch at the base of the limb, and in the appendage becoming green and filamentous at the tip instead of ending in a knob. It may be a variety of *A. Barnesii* or, less probably, a cross between this species and *A. tylophorum* in which most of the characters of the former are dominant.

Species as a whole:
Number of leaves with odd number of leaflets: 67.
Number of leaves with even number of leaflets: 14.

A. convolutum. Pennant Shola, Nilgiri Downs. 21-5-33 and 3-6-33.

Each plant had one leaf.
Males: 1 (7), 4 (8), 11 (9), 11 (10), 7 (11), 2 (12), 1 (13).
Females: 2 (10), 4 (11), 6 (13), 1 (13), 1 (14), 1 (15).
Number of leaves with odd number of leaflets: 26.
Number of leaves with even number of leaflets: 26.

A. translucens. Thiashola. 9 and 12-6-33.

Each plant had one leaf.
Males: 2 (6), 7 (7), 9 (8), 15 (9), 11 (10), 3 (11).
Females: 3 (11), 5 (12).
Number of leaves with odd number of leaflets: 28.
Number of leaves with even number of leaflets: 27.

A. tylophorum. Thiashola 8-6-33 and Neduvattam 14-6-33.

Each plant had one leaf.
Males: 19 (5), 8 (6), 5 (7).
Females: 1 (5), 10 (6), 24 (7).
Number of leaves with odd number of leaflets: 49.
Number of leaves with even number of leaflets: 18.

(The proportion of plants having odd numbers of leaflets was considerably greater than is indicated by the above figures, as at the time of counting, the inflorescences of many male plants had disappeared. There were very many leaves with five leaflets, but it was not possible to be certain in many cases whether these were immature plants or males whose inflorescences had died off. Only plants with recognisable inflorescences were counted.)

On examining these figures it will be seen that only in two species, *A. translucens* and *A. convolutum*, are there approxi-

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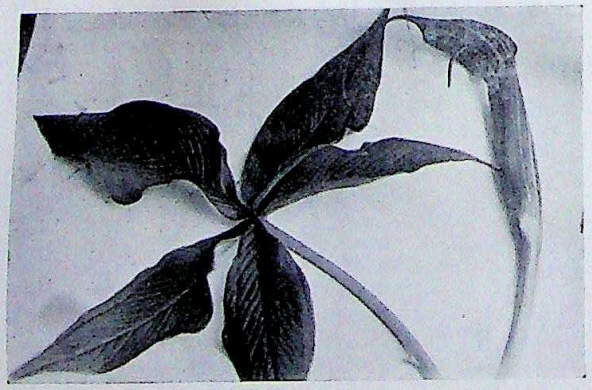
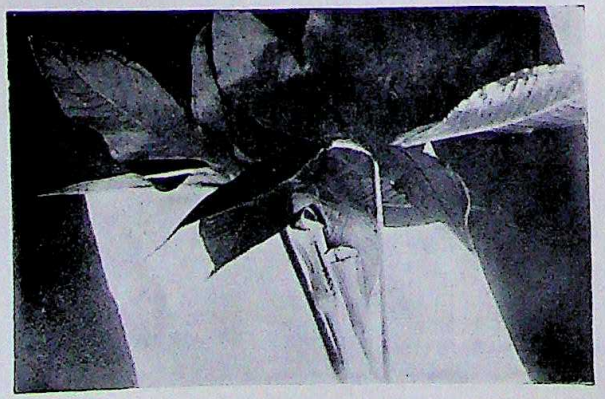
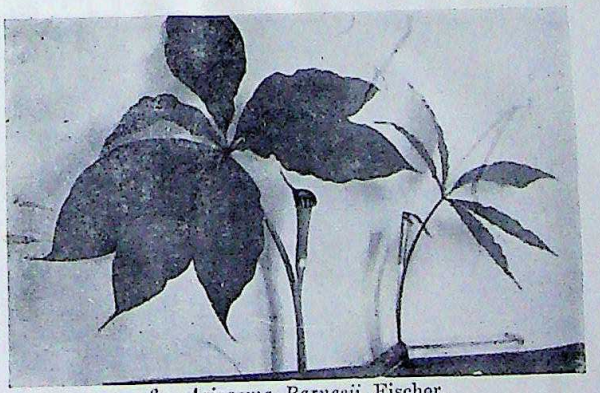


5. *Arisaema Wightii.*



7. *Arisaema tylophorum* Fischer.



6. *Arisaema Barnesii* Fischer.
Female left. Male right.

8. *Arisaema convolutum* Fischer.

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mately equal numbers of leaves with an odd and an even number of leaflets. In these two species only may the leaves be regarded as strictly radiatisect, and even in these the leaflets are not all of exactly the same size. In the other species the leaves with an odd number of leaflets are in a large majority. The leaves of *A. Barnesii* and *A. tylophorum* are therefore to be regarded as palmate. *A. Wightii* has obviously palmate leaves. In the case of *A. Leschenaultii*, the count suggests that the palmate arrangement of the leaflets is not very pronounced; the leaflets are of slightly different size, but mere inspection gives the impression of a radiate leaf. *A. tortuosum* stands apart in having pedately arranged leaflets.

These results may be interesting in connection with the evolution of this genus. It appears probable that the species having most typically radiatisect leaves (*A. convolutum* and *A. translucens*) have evolved from plants having sagittate simple leaves, which are common in related genera, by way of genera having palmate leaves. This suggestion is supported by the fact that in *A. convolutum* and in *A. Leschenaultii* (and probably in other species) in the bud the leaflets are arranged in three groups, one at the end of the petiole and in a line with it, and one folded downwards on each side of the petiole.

Proportions between the Sexes

The following figures were obtained at the same times as those of the previous section.

A. Leschenaultii. This species is dioecious.

Female: 28.
Male: 253.

It is seen that nine times as many male as female inflorescences were found. It is thought that probably there is not a constant ratio between the sexes, but that the ratio varies with conditions. In making the count it was noticed that in moist and more favourable situations females were relatively more numerous than in dry places. In Governor Shola, which is much moister in May and June than Longwood Shola, no complete count was made, but females appeared to be almost as numerous as males.

A. tortuosum. Some inflorescences contain both male and female flowers, and others male only.

Monoecious: 24.
Male: 26.

A. Barnesii. This species is dioecious.

Typical: Female: 5. Male: 51.
Non-typical: Female: 3. Male: 14.

A. convolutum. This species is dioecious.

Female: 15.
Male: 37.

In this case males were certainly relatively more numerous

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than these figures indicate. Many leaves were seen without inflorescences; some of these were immature plants, but many were males whose inflorescences had died and disappeared, the leaf expanding fully later than the opening of the inflorescence in this species.

A. translucens. This species is dioecious.

Female: 8.
Male: 47.

A. tylophorum. This species is dioecious.

Female: 35.
Male: 32.

This count was taken too late in the season when many male inflorescences had disappeared. Almost certainly males outnumber females.

It is seen that in the dioecious species, with the possible exception of *A. tylophorum*, the male inflorescences greatly outnumber the females. In the case of *A. tortuosum* there are almost equal numbers of male and monoecious inflorescences.

Fertilisation

A. Leschenaultii. In this species at the bottom of the tube of the spathe in front where the edges overlap, it will be noticed that in the male inflorescence the two edges arch away from one another so as to form a small roundish orifice about 1 × 2 mm. in medium-sized plants (Fig. 1). The male flowers do not extend to the bottom of the spadix, but there is a bare space at the base of the column. At the same level the spathe is slightly dilated. There is thus an annular space at the bottom of the inflorescence for which the orifice referred to acts as an exit. In the case of the female inflorescence there is no definite orifice at the base of the spathe, but the outer edge of the spathe is slightly thickened and presses firmly on the under edge and overlaps it to a greater extent than in the case of male spathes. The female flowers also extend to the bottom of the column in most cases so that there is no free annular space, or only a very narrow one. The way in which these modifications of the spathe aid cross-fertilisation appears to be as follows. An insect entering a male inflorescence is able, if not too large, to crawl down the spadix to the bottom, and by way of the annular space get to the orifice and escape. It is probable that insects crawl down the spadix and not down the inner side of the spathe as the surface of the latter is very smooth (and, incidentally, not wetted by water). The obvious purpose of the appendage of the spadix appears to be to attract insects and lead them to the fertile parts of the inflorescence. In a well-developed male inflorescence of about average size there were found to be 130 male flowers each consisting of 3 or 4 stamens. The male flowers at the middle of the fertile part of the spadix ripen first, then those lower down, and lastly the uppermost. The indehisced anthers contain so much pollen that they are distended to about three times the diameter of the empty

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cell. When the ripe anther is touched, the pollen is exuded in great quantity through a slit in the top. So much pollen is produced that by the time all anthers have dehisced the annular space at the bottom of the inflorescence is usually choked with it. An insect that enters the inflorescence and makes its escape by the orifice will therefore almost certainly carry away a good deal of pollen with it. If in crawling down the spadix it does not get covered with pollen from the dehiscing anthers with which it comes into contact, it will do so in wading through the pollen in the annular space at the bottom. Should such an insect now enter a female inflorescence it will crawl down the appendage of the spadix to the female flowers. The ovaries are packed tightly together and the insect will have to pass between two rows of stigmas. Before reaching the bottom, however, it will get jammed, as space becomes more and more restricted owing to the conical shape of the column on which the female flowers are packed. In its struggles to escape, the insect is very likely to scatter a good deal of the pollen it is carrying onto the stigmas in its neighbourhood. Numerous insects thus caught are found in almost every female inflorescence after it has been open for a few days. A collection of such insects was forwarded to the British Museum and Dr. F. W. Edwards has very kindly furnished the following determinations.

Tube A.

Contains 6 species of *Mycetophilidae*:

Platyura sp. 1, 2 specimens.
Acnemia sp., 1 specimen.
Phronia sp., 5 specimens.
Mycetophila sp., 1 specimen.
Delopsis sp. 1, 1 specimen.
Delopsis sp. 2, 1 specimen.

Tube B.

Contains the following *Diptera*:

Mycetophilidae.
Platyura sp. 1, 1 specimen.
Platyura sp. 2, 1 specimen.
Sciophila sp., 1 specimen.
Sciara (at least 3 spp.), 12 specimens.
Dolichopodidae.
Psilopus sp., 2 specimens.
Neurigona sp., 1 specimen.
Phoridae.
Gen. indet., sp. 4, 1 specimen of each.
Acalyptrata.
Gen. indet., sp. 2, 1 specimen of each.
Also 3 small *Homoptera* (2 species).

The flies in Tube A were all small enough to be able to escape from the male inflorescence by way of the aperture at the base of the spathe. It appears probable therefore that some or all of these insects are concerned in cross-fertilisation of this species of *Arisaema*.

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The insects in Tube B were all of such a size that they would not be able to escape from a normal sized male inflorescence by way of the aperture. They would therefore appear to be casual visitors and not usually concerned in cross-fertilisation. In addition to these insects a number of other visitors are frequently found in the inflorescences. A small spider finds them a good hunting ground, a cricket appears to use them to shelter in and a small caterpillar finds in them a suitable place for pupation.

On the female spadix above the fertile flowers there are almost always a number of filiform neuters. The uppermost of these are often turned upwards at some distance from the end. These neuters probably act as an obstacle to large insects which, as they are not likely to be carrying pollen, are to be excluded, for they are likely to damage the female flowers or at least to act as obstructions. Neuters are very rarely found on male spadices.

The large excess of male inflorescences (see previous section) makes it likely that many of the smaller insects that enter a female inflorescence will have previously been in a male inflorescence. The length of time the inflorescences remain open probably varies with elevation and weather. A male inflorescence observed lasted 10 days and a female one showed no signs of being over after an equal length of time. This long period of activity will also help to insure efficient cross-fertilisation. That cross-fertilisation is successfully brought about is shown by the high percentage of ovaries that develop. In a plant that was examined it was found that out of 155 ovaries all were developing except three, and these developing berries contained 1-7 seeds, mostly 3, 4 or 5. Two female inflorescences examined had respectively 7 and 12 neuters and 125 and 198 female flowers which contained up to 9 ovules.

The inflorescences of all the species of *Arisaema* referred to in these notes have an unpleasant smell, which is doubtless for the purpose of attracting the flies concerned in their cross-fertilisation. In many specimens the smell is not very strong and it is difficult to locate the place of origin of the smell. In some large specimens of *A. Leschenaultii* found in Thiashola which had dark purple spathes and very stout appendages to the spadix, the smell was very strong. By cutting off the spathe at the base and smelling the various parts of the inflorescence, it was found that the smell came from the appendage of the spadix. By contact with the appendage the upper part of the tube of the spathe had also acquired the smell, but other parts appeared to be free from it. The pendant acuminate or caudate end of the limb of the spathe probably serves as a first alighting place for the attracted flies. What induces the flies to penetrate to the bottom of the inflorescence is not obvious.

A. tortuosum. In this species there is an aperture at the base of the spathes of both the male and the monoecious inflorescences. The probability of cross-fertilisation taking place is obviously increased if the insect is able to escape from one monoecious inflorescence and enter another.

As in *A. Leschenaultii* the smell is definitely associated with the appendage of the spadix. Here the long exserted appendage

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serves both as an attraction to the flies because of its smell, and as an alighting place for them. The lowest male flowers ripen first. Ovaries contain up to 7 ovules. Three ripening spadices had 112, 141 and 167 berries, which mostly contained 3, 4 or 5 seeds.

A. translucens and *A. Barnesii*. In these species there is an orifice at the base of the male spathe, but not in the case of the female. The general scheme for cross-fertilisation is probably like that in *A. Leschenaultii*. The smell was not sufficiently strong in the specimens examined and the parts were too small for the locating of the source of the smell. In the non-typical form of *A. Barnesii* female inflorescences had about 100 ovaries containing 4-8 ovules. The berries contained one or two seeds.

A. convolutum. In this species there is a definite orifice at the base of the male spathe, but not at the base of the female. Cross-fertilisation is probably brought about as in *A. Leschenaultii*. In contrast with *A. Leschenaultii* and *A. tortuosum*, in this case it is the very long tail of the limb of the spathe that is the source of the very unpleasant smell that the inflorescence has; this tail also serves as a settling place for the flies that are attracted.

One plant had 185 female flowers and the ovaries contained up to 4 ovules.

A. tylophorum. In this species the base of the spathe in both male and female inflorescences is dilated. There is a definite aperture in the case of the male spathe and apparently one in the female, but observations are incomplete. There are fewer flowers to an inflorescence in this species than in the others—about 60-80 in both male and female—and it appears probable that the scheme of cross-fertilisation is not quite the same as with *A. Leschenaultii*. The inflorescences have only a faint smell and its location could not be determined. There are usually 6 ovules in each ovary, sometimes 5 or 4. There are usually 1 or 2 seeds in each berry, occasionally three.

In each of these species the pollen consists of spherical bodies 0.015-0.02 mm. in diameter: in *A. Leschenaultii*, *A. Barnesii* and *A. translucens* the surface of the grains is slightly echinate; in *A. tortuosum*, *A. tylophorum* and *A. convolutum* it is granular.

Folding of the Spathe

In this genus one side of the spathe overlaps the other side. It was thought that it would be of interest to find whether, as in certain twining plants, some species are right-handed and others left-handed.

The following figures were obtained:—

	Right	*Left*
A. Leschenaultii	66	52
A. tortuosum	22	6
A. Barnesii	27	29
A. convolutum	14	15
A. translucens	23	30
A. tylophorum	36	25

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(Right means the side of the spathe on the observer's right overlaps the other side, and left the opposite. No distinction is made between males and females in this count.)

It is quite definite that none of these species is completely right- or left-handed. In the cases of *A. Barnesii* and *A. convolutum* the right side is the outer as often as the left. The right side appears to overlap the left more often than the reverse in *A. Leschenaultii*, *A. tortuosum* and *A. tylophorum*, and the opposite is the case with *A. translucens*. Whether the statements made in the last sentence would be confirmed if sufficiently large numbers were counted appears to be somewhat doubtful.

Root and Vegetative Reproduction

In *A. Leschenaultii* there is a corm, oblately spherical in shape and up to about 2 in. in diameter in normal-sized specimens. The under surface is very much puckered and pale green in colour. Dissection shows that this puckered surface is that of the corm of the previous season. In May it is only about $\frac{1}{8}$ in. thick and easily separates leaving the surface of the new corm white and smooth. The foot of the stem is broadened where it joins the corm and from this broadened base there emerge about 20 stout fleshy roots. These roots radiate more or less horizontally. They have numerous branches and these are provided with root hairs. The surface of the main roots is puckered transversely for its first inch or two and is pinkish, this colour being due to numerous minute pinkish-purple longitudinal dashes. The finer roots are white and the root tips yellow. The lowest part of the stem is covered with a brown membranous skin broken irregularly along its upper edge. Above and within this there are three or more membranous blunt-tipped leaves clasping the stem; these vary in colour from white below to dark purple above. From the outer edge of the corm at a slightly lower level than that at which the roots emerge, and originating apparently from the old corm, several underground stems grow out. These run horizontally for about 4 ins. and the tip enlarges till it is about $\frac{1}{2}$ in. in diameter. The greater part of the stem then shrivels and the enlarged part forms a new corm. The horizontal stems and the enlarged ends are covered with membranous blunt-tipped scales which are brown, except the two end ones which cover the bud on the corm, and these are light purple. The newly-formed corm is pear-shaped and lies horizontally with the bud at the blunt end and the residue of the stem at its narrow end. Apparently these corms produce only a leaf next season and establish a larger corm, and produce an inflorescence only in a subsequent season.

In *A. tortuosum* the under side of the corm is covered with the cream-coloured shrivelling residue of the corm of the previous season. Embedded in this old corm near its edges there are to be found several small spherical white corms. These have their bluntly conical buds facing upwards. Round the bottom of the stem just above the level at which the roots emerge small buds are found. It appears, therefore, that in this species the new corms take two years to form, being present as buds on the side

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of the mature corm one year and developing in the residue of that corm the next season.

In *A. convolutum* small upward-pointing corms were found round the upper part of the mature corm. An immature plant growing near a mature one had a corm about $\frac{3}{4}$ in. in diameter. On one side of this small corm there was a brown shrivelled stem which tapered down to about $\frac{1}{8}$ in. in diameter. This narrow end was near the upper part of the corm of the mature plant and had evidently grown out of it although connection had now ceased. Whether the underground stem and the small corm on the side of the mature one are somewhat different modes of reproduction or only stages of the same mode is not certain.

In the case of *A. translucens* underground stems developing into corms are also found. In June stems were found about 5 ins. long; the forward $1\frac{1}{2}$ ins. was enlarged to about $\frac{1}{2}$ in. in diameter and the other part was shrivelling. The widened end was dark green with purple markings, and narrowed suddenly to a long point. Round the terminal bud there were a few membranous scales and behind these a few white root-tips were emerging.

In the case of *A. tylophorum* there were small corms emerging from the upper part of the mature corm at a slightly higher level than the roots. These were found on immature plants that had not yet produced an inflorescence as well as on mature male and female plants. No underground stems were found and the fact that the small corms had their tips pointing upwards suggests that they develop beside the parent plant. Small corms with tips upwards were also found round the upper part of the mature corm in *A. Barnesii*.

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WANDERINGS OF THE BOMBAY-DUCK, *HARPODON NEHEREUS* (HAM. BUCH.), IN INDIAN WATERS.

BY

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(*With* 8 *text-figures*).

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TAXONOMY.

The first scientific reference to the fish known as 'Bombay-Duck' is found in Hamilton's *Gangetic Fishes*.[1] The species was discovered[2] by him 'in the mouths of the Ganges', and doubtfully referred to the genus *Osmerus*. In 1825, however, La Sueur[3] proposed the genus *Harpodon* for his *Salmo microps*, which, later on, proved to be synonymous with *Osmerus? nehereus* Ham. Buch. As often happens, the fish was described under various names by different ichthyologists till the present name—*Harpodon nehereus* (Ham. Buch.)—was assignd to it by the famous ichthyologist Dr. A. Günther in his *Catalogue of Fishes in the British Museum* (vol. v, p. 401, 1864). Since its discovery, the fish has been found in widely separated localities and its range is now known to extend 'from Zanzibar to China, seas and estuaries of India, most common at Bombay but decreasing in numbers down the Malabar Coast. It is not very common at Madras but augments in numbers up the Coromandal Coast, being very abundant in the rivers and estuaries of Bengal and Burmah. Bleeker observes that it appears to be very abundant in the straits of Malacca, more rare at Java, and uncommon at Batavia.'[4] For a considerable time, the genus *Harpodon* remained monotypic and was included in the family *Scopelidae*, comprising exclusively marine, pelagic or deep-sea fishes. In 1881, Günther[5] described

[1] Hamilton, "*Gangetic Fishes*", p. 209 (Edinburgh, 1822).
[2] In the 'Original Notes' concerning the *Gangetic Fishes* the description of the species is dated 'Botanical Gardens, 29th January, 1815'.
[3] La Sueur, *Journ. Acad. Nat. Sci. Philadelphia*, v, p. 50 (1825).
[4] Day, *Fish India*, p. 506, pl. cxviii, fig. 1 (1877).
[5] Günther, *Rep. Sci. Res. Challenger*, xxii, p. 180, pl. xlvii, fig. A (1887).

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another species from a single specimen, 27 inches long, obtained at Tokyo by the Challenger Expedition as *H. microchir* and remarked, 'although it is not known at what depth the fish was obtained, it is evident from its organisation that it should be referred to the deep-sea fauna'. A few years later, a third species, *H. squamosus* was described by Alcock[1] from the Bay of Bengal occurring at depths ranging from '240 to 276 and 281 to 258 fathoms'. Quite recently a new species, *H. mortenseni*, has been described by Hardenberg[2] from the Bali Sea from a depth of 300 meters.

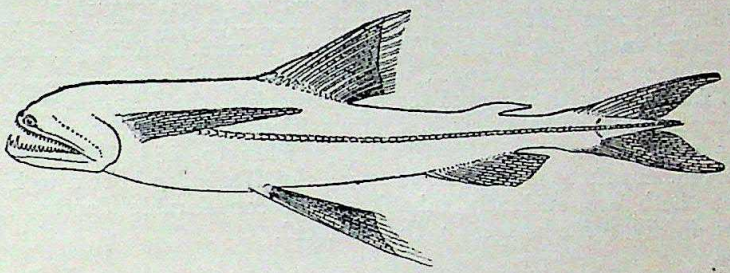

Fig. 1.—Lateral view of a young specimen of *Harpodon nehereus* (Ham. Buch.). $\times\frac{3}{5}$.

Bombay-Ducks are elongate and rather compressed fishes, in which the head is thick, short and provided with a very short rounded snout. The scales are cycloid and deciduous. A lateral line is present. The cleft of the mouth is very wide and is bordered above by the slender, long intermaxillary bone; the maxillary bone is absent. The lower jaw is prominent. Both the jaws are provided with unequal, partly covered, subulate and depressible teeth in a band; the inner teeth, especially in the lower jaw, are enlarged and conspicuously hastate. There are similar teeth in one or two rows on the vomer, palatines, pterygoids, tongue and branchial arches. The dorsal fin is in the middle of the length without the caudal, and there is also a narrow adipose fin opposite to the middle of the anal fin. The caudal fin is three-lobed. The ventral fins are exceedingly long. The gill-openings are extremely wide and are covered with membranous opercula. The branchiostegal membranes are free and extend beyond the opercula. There are 17 to 25 branchiostegal rays.

The exact affinities of this remarkable genus are not well known, but it is no longer included in the family *Scopelidae*. Goode and Bean[3] and Regan[4] refer it to the family *Synodontidae* (*Synodon*, *Saurida*, *Bathysaurus* and *Harpodon*), while Jordan[5] has proposed

[1] Alcock, *Ann. Mag. Nat. Hist.*, p. 127 (1891); *Ill. Zool. Investigator*, pl. xxx, fig. 1.
[2] Hardenberg, *Treubia*, xiv, pp. 221-222, fig. 1 (1934).
[3] Goode & Bean, *Oceanic Ichthyology*, p. 59 (Washington, 1895).
[4] Regan, 'Fishes' in *Encyclopaedia Britannica*, 14th ed., ix (1929).
[5] Jordan, *Classification of Fishes*, p. 154 (California, 1923).

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a new family for this genus. Weber and Beaufort[1] have treated the genus under the order *Myctophoidea* and finding 'no concordance among ichthyologists' regarding the forms treated under Iniomi, they have not grouped the Indo-Australian genera into families.

Harpodon nehereus, when fresh, is said to be brilliantly phosphorescent all over the body, but Kemp[2] by his observations on specimens from the Matlah River was not able to corroborate this statement. It shows some curious features that resemble adaptations to deep-sea existence, though it is remarkable that the fish is not known to occur at any great depth. Still further remarkable is the fact that it is not even restricted to the sea, being very abundant in the estuaries of Bengal and Burma. In its gelatinous consistency and large mouth with the lower jaw loosely articulated and furnished with recurved teeth, it resembles the deep-sea species. This resemblance to a deep-sea form misled even so great an authority as Günther, for in his *Study of Fishes* (p. 584, 1880) he remarked, in reference to the two species of *Harpodon* known to him, that 'both are evidently inhabitants of considerable depths, and periodically come nearer to the surface'.

Fishing in Indian Waters.

In a recent article on the 'Fishing for "Bombay-Duck" ', Setna[3] has made some observations on the movements of this fish. He remarks that 'the peak period of the fishing season in Bombay (for "Bombay-Duck") is from June to September, and at this time the inshore waters are the haunts of innumerable kinds of fishes, both large and small, and crustaceans'. Towards the close of the monsoon season, the quantity of the catches of this fish falls off very sharply and inshore fishing is gradually discontinued. In October, it is not worth while to fish for them. After October and till the commencement of the south-west monsoon, the fish is still available in fair quantities but in places about 20 to 25 miles from Bombay. Here they are netted to be discarded as they are liable to putrefy by the time the boats reach the shore, as they have to beat up against the north-east monsoon at this period. According to the statistics collected by Setna, the fish is most abundant in Bombay during September.

The principal fishery of the Bombay-Duck is at the entrance of the Bombay harbour where the water is about 40 to 60 feet deep and the bottom of the sea consists largely of sandy banks. As a result of the trawling on the Western Coast by *William Carrick*, Hefford[4] found that *Harpodon nehereus* was sometimes taken in fair quantities, especially in the shallower water, but it suffered

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[1] Weber and Beaufort, *Fish Indo-Austral. Archipel.*, ii, pp. 139, 150 (Leiden, 1913).

[2] Kemp, *Rec. Ind. Mus.*, xiii, p. 238 (1917).

[3] Setna, *Journ., Bombay Nat. Hist. Soc.*, xxxv, pp. 867-872 (1932).

[4] Hefford, *Report on the Work of the Steam Trawler 'William Carrick'*, May 1921 to February 1922, p. 31 (Bombay, 1923).

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a great deal of damage in the trawl and it was considered profitless to keep it for market. It is unfortunate that no statistics were kept by Hefford regarding its distribution in Bombay waters and the seasons of its occurrence.

Dr. S. B. Setna informs me that he has been examining the gonads of this fish during the intensive fishing season off the Bombay Coast and can say with certainty that the gonads are not ripe at any time during June to October, whereas the fish examined in February and March were full of ripe eggs and active spermatozoa. These ripe specimens were taken far out at sea. Females with eggs were taken mostly in November and December while the young fish have been observed mainly in January and February.

According to Sorley,[1] the chief fishing grounds for *Harpodon nehereus* in the Bombay Presidency are in the area off Bombay extending northwards towards the Gulf of Cambay. In this region Bombay-Duck appears to be one of the commonest fish. On the south side of Bombay, the waters are deficient in this species and no regular fishing for it exists. Sorley states that in the Konkan area Bombay-Ducks usually appear in October to December and March to May when they 'come in shoals landwards to escape predaceous fish that pursue them'. From his enquiries, Sorley is led to believe that Bombay-Duck would be found to have a distinct oceanographical distribution.

In the Madras waters, *H. nehereus* is found in fair numbers at the mouths and in the estuaries of the Kistna and Godavari Rivers and along the Ganjam Coast. In 1916, Govindan[2] recorded that this species is not brought to the yards on the west coast, whereas on the east coast the curing yards at Calingapatam, Kommaravanipeta and Pukkillapeta in the extreme south coastal region of the Ganjam District receive it throughout the year. Hornell[3] in his statistical analysis of the fishing industry at Tuticorin makes no mention of *H. nehereus* among the principal food fishes that are caught there. Similarly Nayudu,[4] in his statistical analysis of an inshore fishing experiment at Madras during 1919, does not record this species in catches from Rayapuram. Moses,[5] while investigating the fish supply of Madras, found that 'Vangaravasi (*Harpodon nehereus*), the Bombay-Duck, is a rare fish, 10 lb. having been available in March'. Mr. P. E. P. Deraniyagala of the Department of Fisheries, Ceylon, has informed me that 'the fish known as Bombay-Duck "*Harpodon nehereus*" has never been captured by us when trawling on Pedro or Wadge banks. . . . I have never noticed it at any of our fish markets.' These observations indicate that the species is very rare, if not totally absent, from the Malabar Coast and the Coromandal Coast as far up as Madras, while at the mouths of large rivers northwards and

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[1] Sorley, *The Marine Fisheries of the Bombay Presidency* (Bombay, 1933).
[2] Govindan, *Madras Fish. Bull.*, ix (1916).
[3] Hornell, *Madras Fish. Bull.*, ix (1916).
[4] Nayudu, *Madras Fish. Bull.*, xi, pp. 61-119 (1917).
[5] Moses, *Madras Fish. Bull.*, xv, pp. 131-166 (1922).

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along the Ganjam Coast it makes its appearance in sufficient numbers to be of some commercial importance.

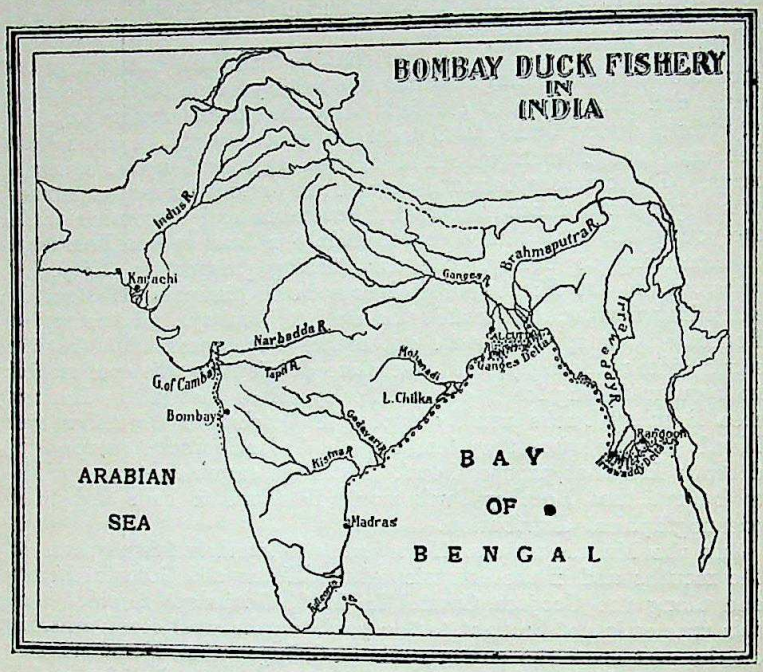

Fig. 2.—Chart showing principal centres of Bombay-Duck fishery in India.
● shows abundance of fish.
O shows possible occurrence of fish.

In Bengal, so far as I have been able to ascertain, *Harpodon nehereus* is not sold inland either in the fresh or dried condition. The fish is so delicate and the means of conveyance so primitive that it is not even brought to the Calcutta market from the lower reaches of the Gangetic Delta. At Chittagong, Noakhali and Bakargang 'the fish is largely caught and sold, and is esteemed as a good fish by all classes, both as fresh or dried.'[1] Gupta[2] in his preliminary report on the fisheries of Bengal mentioned *Harpodon nehereus* as one of the fish commonly caught in the estuaries and remarked that 'Bombay-Duck (*Harpodon nehereus*) is by no means rare, especially at the Sandheads; if it could be brought into Calcutta fresh, it would find a ready market'. As a result of the trawling operations of the 'Golden Crown', it was ascertained that *Harpodon nehereus* is more abundant round the Mutlah light vessel and right away to the westward of it past the entrance to the Eastern Channel down to the vicinity of the Pilot's Ridge.

[1] De, *Report on the Fisheries of Eastern Bengal and Assam*, p. 26 (Shillong, 1910).
[2] Gupta, *Coll. Papers Fish. Surv. Bengal*, pp. 2, 6 (Calcutta, 1911).

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Jenkins[1] considered the species as 'a true estuarine form, the young of which are found all over the Sunderbans in brackish water'. From the details of the fish caught by the 'Golden Crown', it appears that the species was obtained in sufficient numbers to be recorded for commercial purposes only during trips 8, 9, 10 and 27. Though during the first three of these trips the trawler worked on the Orissa Coast between Konarak (Black Pagoda) and Puri, the Bummaloes seem to have been obtained during its passage up and down the estuary. During trip number 27, the 'Golden Crown' trawled off the entrance to the Eastern Channel, on Pilot's Ridge, off the Devi River, off Konarak and then again off the Eastern Channel. Details of the catches of Bombay-Duck made by the 'Golden Crown' are given below:—

No. of trip.	Time of the year.	Quantity in lbs.
8th	1st to 5th October, 1908.	450
9th	11th to 15th October, 1908.	350
10th	22nd to 29th October, 1908.	315
27th	24th November to 3rd December, 1909.	100

According to Southwell,[2] Bombay-Duck is 'very plentiful in the river between the sea and Diamond Harbour; in the vicinity of the latter place it was scarce and ten miles further north entirely absent'.

I am informed by the fishermen of Port Canning (Matlah River) that *Bummalo* is to be found in the Matlah River in fair quantities during the cold season from November to February, and that it disappears during the rainy season. Both young and adult forms are found. While investigating the brackish water fauna of the Piali Nadi at Uttarbhag, 25 miles from Calcutta, it was observed that in February to March large quantities of *Harpodon nehereus*, mostly young, were captured during spring tides, while at other periods the fish was absent or very rare in the fish market.

For an ecological account of the estuarine area reference may be made to Kemp's[1] paper on the fauna of the Matlah River. There are two main factors in this environment, the nature of the bottom which consists of very finely divided, soft mud and the seasonal variation in the salinity of these waters from almost fresh to highly brackish. In December 1915, Kemp found *Harpodon nehereus* fairly abundant in the Matlah River, where the conditions for its existence are very similar to those prevailing in the deep-sea. The bottom fauna of the Matlah River, including

[1] Jenkins, *Coll. Papers Fish. Surv. Bengal*, p. 66 (1911).
[2] Southwell, *Rec. Ind. Mus.*, xi, p. 329 (1915).
[3] Kemp, *Rec. Ind. Mus.*, xiii, pp. 233-241 (1917).

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Harpodon nehereus, has a superficial resemblance to the deep-sea fauna.

H. nehereus is found in fairly large numbers along the coast of Burma but is chiefly caught at Akyab and in the deltaic region of the Irrawaddi. Unfortunately I have not been able to find any reference to the fishery of this species along the Burmese Coast so it is not possible to give statistics of catches.

The Secretary to the Financial Commissioner, Burma, informs me that 'the fish known as Bombay-Duck (locally known as *Baraga*) are not found in large numbers in this province. They are found in estuaries and salt-water areas of some of the rivers in the Arakan Division mainly during the cold weather. There are no fishing centres for these fish, but they are occasionally caught in nets though they form only a very small proportion of the catches. The fish apparently live in the open sea but go up and down the river with the tide. Akyab is the only district in which they are found in numbers: even in that district it is reported that most of the Bombay-Duck (dried) sold in the bazaars are imported from Chittagong.'

It is clear from the above that the roaming movements of *Harpodon nehereus* are not connected with the reproduction of the species, and, therefore, in the strictest sense, are not migratory. The bionomics of the species are not known. We do not know from where they come and are not acquainted with their usual breeding haunts. The structural features of the body indicate a deep-sea habitat, but we have no knowledge of the fact whether it is a deep-sea or a surface species. Its occurrence round our shores and the fact that Bombay-Ducks are available in Bombay and the estuaries of larger rivers all the year round render the study of the bionomics of the species of special interest. The elucidation of the breeding habits and bionomics of *Harpodon nehereus* will throw a considerable light on the relative merits of the two opposing conceptions in organic evolution—adaptation and predetermination.

Food of *Harpodon nehereus* (H. B.).

So far as I am aware no observations exist on the food of *Harpodon nehereus*. At my request Dr. S. B. Setna sent me two samples of the stomach contents of this species which have shown that *H. nehereus* feeds mainly on small fish and shrimps. The analysis of the fish removed from the stomach of *H. nehereus* has yielded the following results:—

2 young specimens, 30 and 35 mm. long.	*Harpodon nehereus* (H. B.).
1 young specimen, 66 mm. long.	*Trichiurus* sp.
2 young specimens, 35 mm. long.	*Engraulis* sp.
38 specimens, 15 mm. to 70 mm. long.	*Bregmaceros macclellandi* Thomson.

Among shrimps the principal food-species is *Acetes indicus* Milne-Edwards which is represented in the stomach contents by hundreds of specimens. Some larger Palaemonid and Peneid shrimps were also found but their number is insignificant. A young cuttle-fish was also present among the stomach contents of *H. nehereus*.

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It is clear from the above that *Bregmaceros macclellandi* and *Acetes indicus* are the two principal food-species of *H. nehereus*.

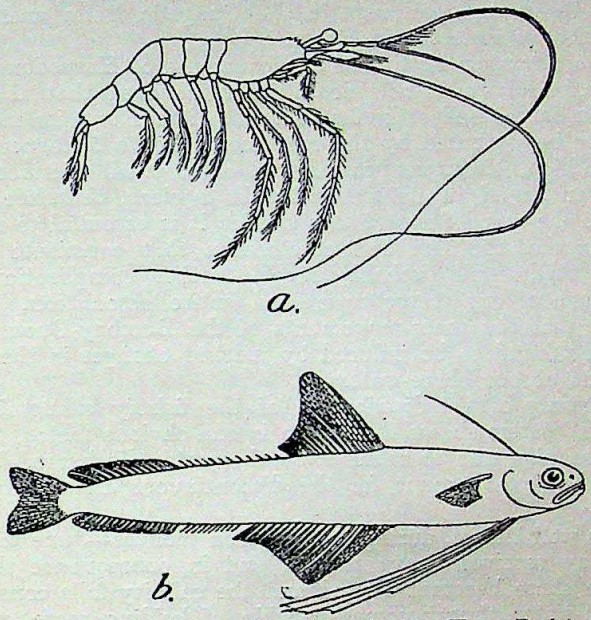

Fig. 3.—Principal food-species of *Harpodon nehereus* (Ham. Buch.).
a. Lateral view of *Acetes indicus* Milne-Edwards (Modified after Milne-Edwards).
b. Lateral view of *Bregmaceros macclellandi* Thompson (Modified after Weber & Beaufort).

B. macclellandi is a small species which is said to grow to about three inches in length; it is found in the mouths of rivers and along the coasts of India to China and the Philippine Islands. *Acetes indicus* is found at Bombay, in the Bay of Bengal and the Gulf of Siam; it is mainly found in brackish waters but also occurs in the open sea near land. It will thus be seen that the range of distribution of the two principal food-species is co-extensive with that of *H. nehereus* and it seems probable that the wanderings of the Bombay-Duck are influenced by the wanderings of the food-species. The subject deserves closer investigation.

Explanation of the Seasonal Occurrence and Distribution of *Harpodon nehereus* in Indian Waters.

From the foregoing account it is clear that *Harpodon nehereus* is numerous in the Gulf of Cambay and down the coast as far as Bombay, becomes rarer all down the Malabar Coast, is absent at Tuticorin and in Ceylon Waters, a few are taken at Madras but it increases largely in numbers along the Golconda Coast and is numerous again along the coasts of Bengal and Burma where it ascends the estuaries of the larger rivers. At Bombay it is found

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near the coast during the monsoon season and is most abundant in September, but in the estuaries and near the mouths of larger rivers it is found throughout the year. Jenkins found a large number of young specimens in the Gangetic Delta and regarded the species as an estuarine form.

The explanation of the mass-movements of *Harpodon nehereus* as depicted above is not clear. It is believed that the species visits our shores and estuaries in quest of food and its movements appear to be governed by the movements of its food-species, such as small fish, shrimps, prawns and other small crustaceans that have been found in its stomach. It is clear, therefore, that to elucidate the wanderings of this species it is essential to study the movements of the fish and crustaceans that constitute its food. Such a study will probably reveal further complications. The disturbance of one factor upsets an entire association, and it is probable that the mass-movements of the Bombay-Duck will ultimately be found to be induced by marked changes in the physical conditions of our shore-waters.

The study of the distribution of the fishery of Bombay-Duck in Indian Waters shows that there is one obvious factor, the effect of low salinity due to rains or to the water discharged by larger rivers, that can account for the discontinuous distribution of the species.

As is well known, during the monsoon months—June to October —Bombay receives heavy rainfall and in consequence the water near the shore becomes diluted and the salinity falls considerably. The sea-water thus becomes capable of holding more oxygen in solution for the respiration of aquatic animals. This lighter and more oxygenated water flowing far out to the sea probably supplies the initial stimulus to the organisms to move towards the shore and then a regular cycle of migrants is set up. Even Bombay-Duck is followed by sharks and other larger fish that feed upon it. Setna (*op. cit.*) has described an ingenious device used by the fishermen of the Bombay coast to protect their catch from the depredation of the larger species.

Our knowledge of the physical conditions of the waters along the western coast is very meagre[1] and I have not been able to find any details of the variation in salinity and temperature during different seasons of the year in this area. However, a perusal of any physical map of India will show that the Gulf of Cambay receives larger volume of water from the Narbada and Tapti Rivers, and that no other big river or stream falls into the sea on the Malabar Coast. There is no doubt that the salinity of the water in the Gulf of Cambay must always be lower than that of the sea and be subject to considerable variation depending on the quantity of water discharged by the rivers at different seasons of

[1] Reference may here be made to the work of Matthews (*Trans. Linn. Soc. London*, Zoology (2), xix, pt. i, pp. 169-205, pls. x-xiii, 1926) on the Physical Oceanography of the Percy Sladen Trust Expedition to the Indian Ocean in 1905. Matthews gives charts of the variation in salinity of the surface waters of the Arabian Sea, but does not deal with the coastal waters which are of special significance for studying the movements of Bombay-Duck.

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the year. It is probable that this diluted sea water affects the salinity as far down as Bombay, but it has also to be remembered that this portion of the western coast receives between 75″ and 100″ of rainfall during June to October, and this is likely to have

Fig. 4.—Chart showing seasonal rainfall in India from June to October.

considerable effect in lowering the salinity of the sea water in the neighbourhood. The accumulative effect of this rainfall will be felt most in September and at this period the salinity is likely to be the lowest. Corresponding with this period of low salinity, we find that Bombay-Duck is most numerous on the Bombay coast in September. This presumption is supported by the popular beliefs of the fishermen of the Bombay Presidency, for instance, 'it is a common belief among fishermen that if there be good rainy season with record floods, the prospects of good sea fishing are assured.' (Sorley, *l.c.*, p. 117.) The rainfall on the Malabar Coast is also heavy, but the rain that falls is drained off by the Godavari, Kistna and Cauvery Rivers, all of which fall into the sea on the east coast (Coromandal Coast). It is thus seen that the dilution of sea water may result from local heavy rainfalls or through the drainage of larger rivers, and it is significant that none of these two factors is operative over the stretch of the coast from below

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Bombay to Madras and the result is that there is no fishing of the Bombay-Duck in the whole of this area.

As a result of the researches of Dallas[1] and Sewell[2] and his predecessors on the 'Investigator', we are in a much better position with regard to the study of physical factors in the Bay of Bengal. At all times the surface water throughout the Bay of Bengal and the Andaman Sea possesses a low salinity owing to the influx of large volumes of fresh water from the great rivers of India and

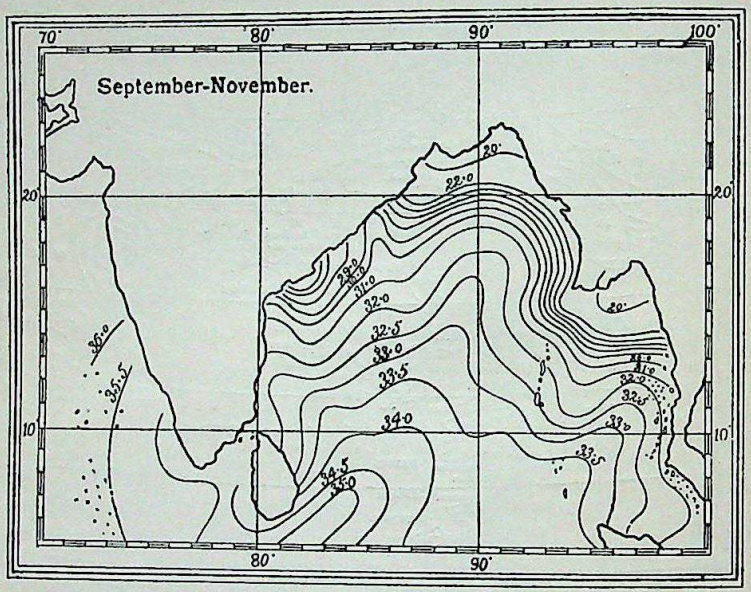

Fig. 5.—Chart showing surface salinity of the Bay of Bengal during the period from September to November (Modified after Sewell).

Burma, and this influx must also to some extent affect the temperature of the surface water. Moreover, the Bay is exposed at different times of the year to such opposite influences as the south-west and north-east monsoons and as most of the larger rivers of India empty themselves into it, one would naturally expect to find that the conditions present in the surface waters would show a considerable range of variation both as regards the salinity of water and its temperature. These variations can be attributed largely to the different seasons of the year. With the changing seasons, the salinity of the surface waters changes considerably, and this can be readily understood by a reference to Sewell's charts, reproduced here in a modified form, of the surface salinity of the

[1] Dallas, *Charts of the Bay of Bengal and Adjacent Sea north of Equator, showing the Specific Gravity, Temperature and Currents of the Sea Surface* (Calcuta, 1887).

[2] Sewell, *Mem. As. Soc. Bengal*, ix, pp. 207-356 (1929).

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Bay of Bengal during September to November, December to February, March to May and June to August. It has to be borne in mind that owing to the geographical configuration of India, most of the rivers of India open into the Bay of Bengal and in consequence the major portion of the rainfall over not only the Indian

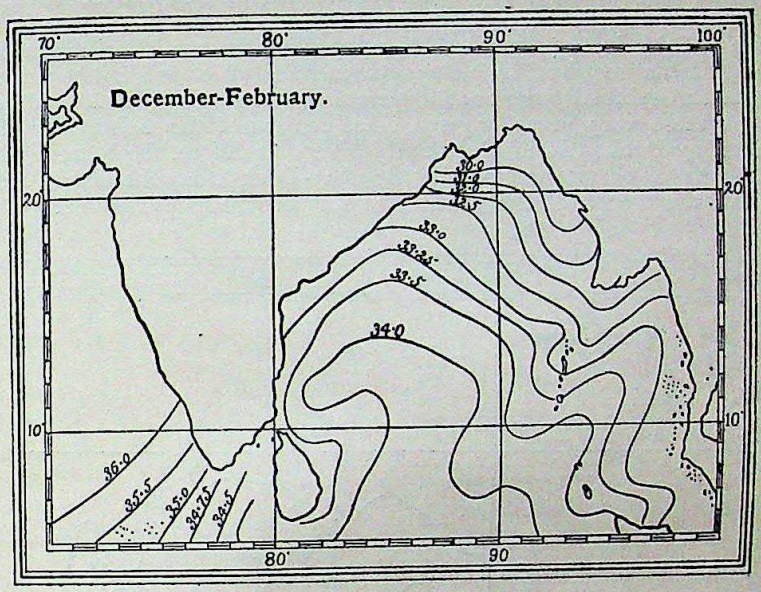

Fig. 6.—Chart showing surface salinity of the Bay of Bengal during the period from December to February (Modified after Sewell).

Peninsula but also the region lying to the north finds its way eventually into the Bay, though this will of necessity take some time, depending on the length of the river. This means that the salinity of the Bay in October will be influenced to a large extent by the rainfall of the preceding south-west monsoon in July and August over United Provinces, Bihar, etc. In this country monsoon forecasts are made use of in connection with agricultural operations, but it is hardly realized that the same forecasts can be made use of in connection with the fisheries. The collective rainfall over India varies from year to year and in any one year the effect of the monsoons may vary very considerably in different parts of India. All these are important considerations in connection with the problems of fisheries in this country.

I have remarked above that the movements of the Bombay-Duck are, in all probability, governed by the stimulus supplied by the low salinity of the sea-water.[1] In this connection the salinity chart of the Bay of Bengal for the quarter September to Novem-

[1] At the head of the Bay the salinity is affected to a depth of at least 50 fathoms.

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ber is of special significance. This chart shows three definite areas of low salinity, (i) the mouths of the Irrawaddy and Salween Rivers, (ii) the mouths of the Ganges and (iii) the Ganjam coast and the mouths of the Godavari and Kistna Rivers. Whereas the low salinity of the Bay at the mouth of the Ganges and the Irrawaddi may be due to the accumulative effect of the south-west monsoon, on the western side of the Bay considerable lowering of the salinity in September to November at the mouth of Godavari and Kistna may be due to the autumn rains which fall in the peninsula and especially the coast districts. It has been indicated above that these very areas are the chief centres of the fishery for the Bombay-Duck. It is abundantly clear, therefore, both from the seasons of occurrence of the Bombay-Duck near the shores and from the record of the areas where it occurs in abundance, that

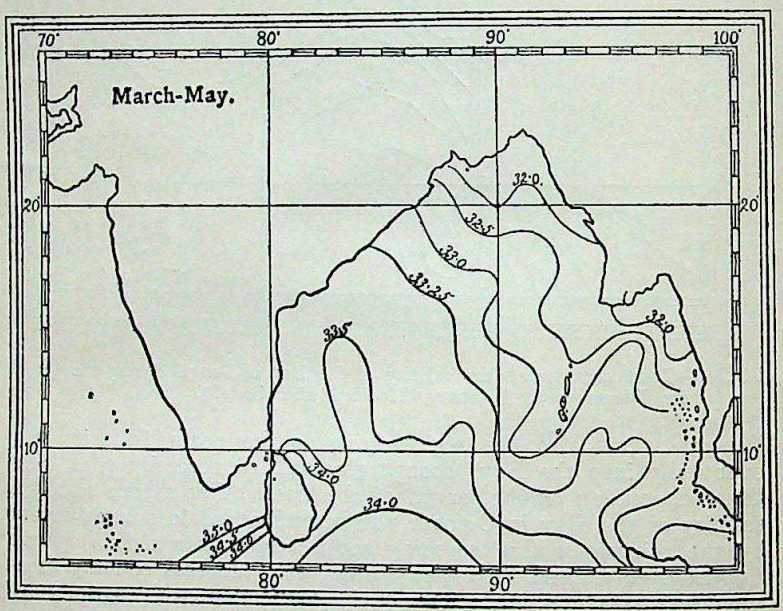

Fig. 7.—Chart showing surface salinity of the Bay of Bengal during the period from March to May (Modified after Sewell).

there is a definite correlation between the low salinity of the water and the occurrence of *Harpodon nehereus*.

The low salinity of water is only one of the factors that bring about the mass-movements of the Bombay-Duck. The river-water and rain-water are more highly oxygenated and have a somewhat lower temperature than that of the sea-water. Another possible factor, especially in the estuarine areas, is the great increase in the available food supply. The flow of the rivers brings down with it great quantity of valuable vegetable debris and detritus. This serves as a source of food for small animals on which larger

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animals prey. Large quantities of nutrient salts, derived from the land, are poured into the sea and this results in a very large increase in the diatom flora, that in turn serves as a food supply for the smaller marine organisms. Probably it is a combination of these and other factors that induce Bombay-Duck to visit our shores. The nature of the bottom does not seem to effect these movements, for near Bombay the sea bottom consists of sandy banks, while in the Bay of Bengal the sea bottom consists of

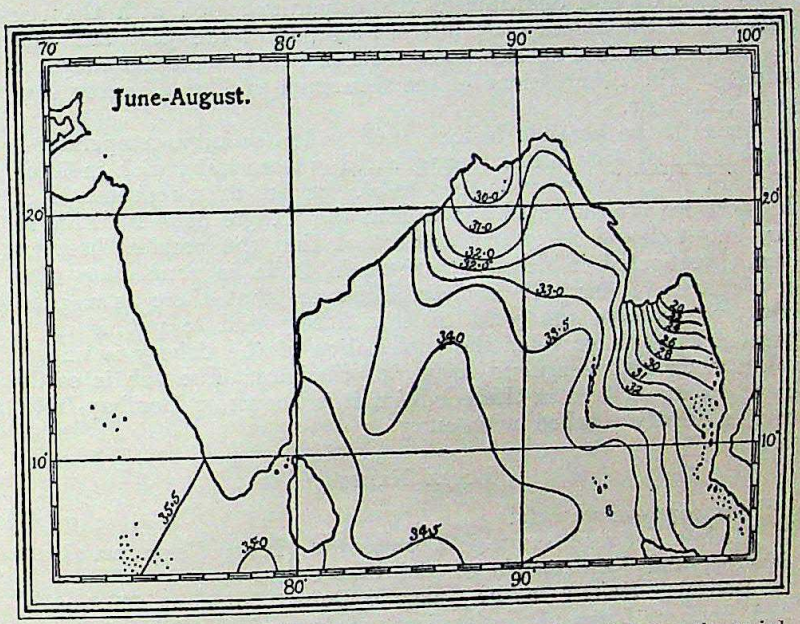

Fig. 8.—Chart showing surface salinity of the Bay of Bengal during the period from June to August (Modified after Sewell).

brown mud in the chief centres of the fishery. As regards the salinity and temperature of deeper waters very little is known.

Judging by the above criterion, there are two areas along the coast of India where Bombay-Duck should be plentiful, but, so far as I am aware, it is not found there. These two areas are the Chilka Lake along the Ganjam Coast and the Delta of the Indus. In both the localities the salinity is very low at times on account of fresh water brought down by rivers, etc. It seems likely that the food-species of the Bombay-Duck do not occur in these areas, and as the movements of the fish are for feeding purposes, its absence in these localities can be explained on this assumption. This is merely a tentative suggestion as the subject has never been investigated so far.

It has been noted above that *Harpodon nehereus* is found in the estuaries of the Irrawaddi, the Ganges, the Godavari and the Kistna Rivers throughout the year, and that young specimens have been collected by several workers from such regions. It seems

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likely that the low salinity and other physical and biological factors of the estuarine waters suit the Bombay-Duck or the species of fish and shrimps on which it preys. In the Ganges, the fish is stated to ascend as high up as Diamond Harbour where on the 5th of March, 1933, I found the salinity to vary from 7.90 per mille (midstream, tide flooding) to 8.50 per mille (near shore, last phase of ebb tide). In the rainy season, the salinity falls considerably lower. It would thus seem probable that Bombay-Duck ascends and descends in the estuarine region with the rise and fall of the salinity at different seasons of the year and that the fish or its food-species does not live below a certain range of salinity. The observations of the fishermen of Port Canning support this view.

Some of the possible factors, such as low-salinity, temperature, movements of food-species, oxygenated water, water rich in food-material etc., that may be responsible for the mass-movements of *H. nehereus* are indicated above from the meagre data available so far, but it should be clearly understood that the problem has not been investigated in detail anywhere in India in connection with any species of fish. It is clear, however, that there is a great scope to increase the yield of this fishery and to put it on a permanent basis provided the exploitation of the fishery is undertaken along well recognised scientific principles. The fish is easily cured by drying and in this condition it is known as Bombay-Duck and is greatly relished with curry.

Local Names.

Bombay:—*Bummalo.*

Madras:—*Cucah sawahri; Cocomottah* (Tel.); *Vangaravasi* at Madras; and *Vanamottalu* on the East Coast.

Bengal:—*Nehare* in the Gangetic Delta; *Lotya* at Chittagong and *Lotia* or *Lotya* at Noakhali and Bakarganj.

Burma:—*Baraga.*

Malay:—*Luli* and *Aruan-tassik.*

When fresh the fish is familiar to Europeans as *Bummalo* and when dried as Bombay-Duck.

Acknowledgments.

I have to express my sincerest thanks to Lt.-Col. R. B. S. Sewell and to Dr. Baini Prashad for going through the manuscript and for making valuable suggestions. Babu R. Bagchi has made all the figures, except figure 4, for this article with his usual skill and care and I am thankful to him for this. Dr. B. Chopra has identified the crustaceans for me and Mr. Dev Dev Mukerji has helped me in various ways. I am greatly indebted to them for their kindness.

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ALIMENTARY CANALS OF FOOD FISHES.

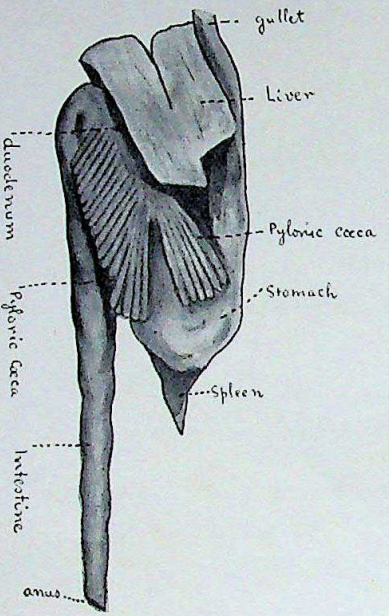

Fig. 1.—*Salmo fario*
Brown Trout.

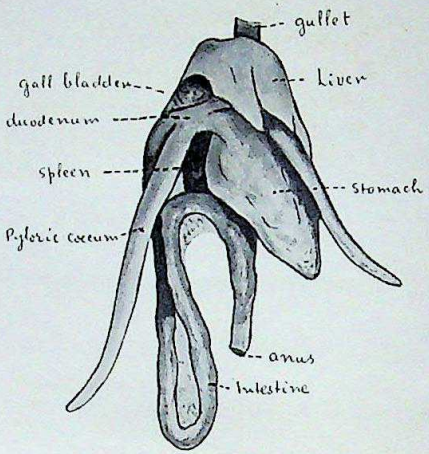

Fig. 2.—*Ophiocephalus marulius.*
Vern. *Saul.*

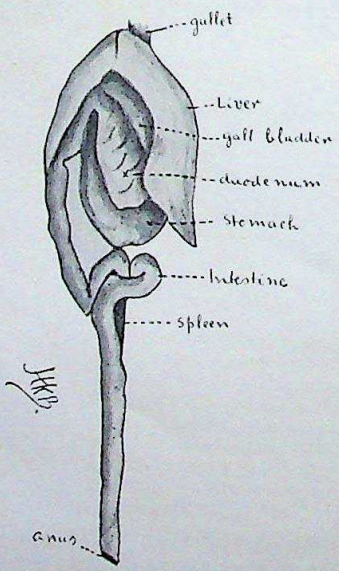

Fig. 3.—*Wallago attu.*
Vern. *Mullee.*

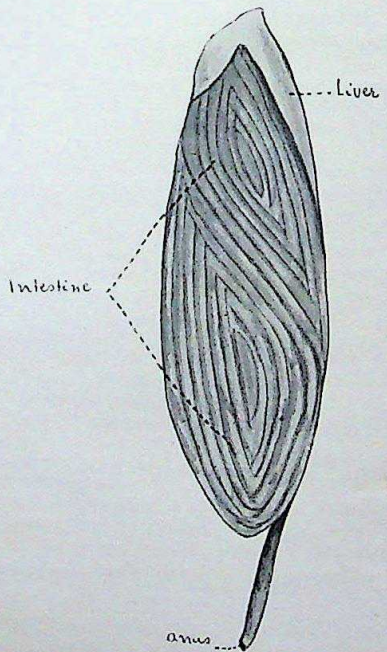

Fig. 4.—*Cirrhina mrigala.*
Vern. *Mori.*

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HABITS AND HABITATS OF FOOD FISHES OF THE PUNJAB.

BY

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(*With one plate*).

Most of the inhabitants of the Province, especially those residing in the hills and in the riverian districts have no scruples to eating fish. There are others who, on religious grounds, do not kill and eat them. Some, however, object to certain kinds of fish which they consider repulsive, while others, though not averse to eating fish, object to them being captured in certain sacred places. Such sacred places are protected under the Fisheries Regulations as *Sanctuaries*[1] and some of these form the best natural spawning grounds of many of the local species and are situated in Kangra, Hoshiarpur, Hissar, Amballa and Jhelum Districts.

Fishes, like other main divisions of the animal kingdom, may conveniently be divided into two groups namely:—

(1) Herbivorous or vegetarian and (2) Carnivorous.

In the first group are included those fishes which live mostly on weeds and other aquatic vegetation such are the *Cyprinidae* (Carps). These fishes are devoid of teeth in their jaws and like all other herbivorous animals, possess a long alimentary canal. They are wholesome and well-flavoured and are consumed in large numbers and without any scruples.

The second group includes those fishes which thrive mostly on animal diet, such as insects, molluscs or other fishes, and also feed on dead bodies. They all possess teeth in their jaws and have a straight alimentary canal. This group may be further sub-divided into *firstly*:—those carnivorous fishes which are voracious, predaceous and consume offal and carcases, such are the *Siluridae* or Cat fishes. Being scaleless, they are forbidden to Jews and Shia Mohammadans. The Jews[2] are only permitted to eat 'Whatsoever hath fins and scales in the waters, in the seas and rivers', and this law is strictly observed by Shia Mohammadans as well. They are not considered very wholesome. *Secondly*:—those carnivorous fishes which live mostly on insects and their larvae, molluscs, crustaceans and other fishes, such are the *Salmonidae*, *Ophiocephalidae*, and others. They are wholesome and are considered excellent eating.

The difference in the alimentary canal of the carnivorous and vegetarian fishes is remarkable. In *Salmo fario* (Brown Trout, fig. 1), the short gullet leads into a U-shaped stomach, and the intestine after the duodenum becomes bent upon itself and then passes backwards without any convolution. There are forty-six blind glandular tubes, the pyloric caeca, which open into the duodenum. In *Ophiocephalus marulius* (Murrel: fig. 2), the short gullet opens into a bag-like stomach, which is capable of accommodating prey of any length. In a 14'' Murrel, with a normal stomach of 1'', a *Botia* of 2·7'' was found extending from the gullet to the posterior extremity of the stomach. The intestine, after the duodenum, becomes bent upon itself and then passes backwards, without any convolution, to the anus. Two pyloric caeca open into the duodenum. In *Wallago attu* (*Vern. Mullett*, fig. 3), the short gullet opens into a wide stomach, capable of being stretched to a considerable extent. The intestine after the duodenum, becomes bent upon itself and then with one convolution passes backwards to the anus. In *Cyprinidae*, e.g., *Cirrhina mrigala* (*Vern. Mori*, fig. 4), the gullet passes into a long tubular stomach, and the intestine is convoluted like a watch spring. The intestine, if fully extended, measures many feet in length.

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[1] Hamid Khan, *The Punjab Fisheries Manual*, 1930, p. 12.
[2] Day, F., *Ind. Med. Gaz.*, Vol. vi, 1871, pp. 5-8 and 26-29.

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The Punjab with all its rivers, canals and jhils is essentially a fish producing tract of country. Its fisheries extend from the junction of the five rivers to almost every place where water exists in any quantity even high up in the hills. Important fishing waters[1] in the Province are the following:—

1. The Indus River and its tributaries, such as Chel, Haro, Reshi, Soan, Chablat, Saggar, Nandra, Shakardara Fatehjung Sil, Wadala and Pindigheb Sil, Sohan, Kurang, Leh and Ling in Attock and Rawalpindi Districts. These are mostly Mahseer waters.

2. The Jhelum River with its tributaries, and canals with their heads at Mangla, and Rasul. Tangrot, the famous Mahseer sporting resort is on the River Jhelum in Kashmir State territory.

3. The Chenab River and its tributaries, such as Nalas, Palkhu, Dhan, Sabskot, Gadgor, Lunda, Tawi, Bhimber, Bhandar, etc., and its canals with their Heads at Marala and Khanki.

4. The Ravi River and its tributaries such as Basantar, Aik, Deg, Bhed, Sakki, Naumani, Naluha, Ujh, etc., and its canals with their Heads at Madhopur, Balloki and Sidhnai.

5. The Beas River and its tributaries, the 'Trout Waters' in Kulu such as Sarbarri, Sainj, Tirthan, Parbatti, Chhaki, Fojal, Nashal, and Uhl streams; and Mahseer streams of Kangra Valley e.g. Binnun Khad, Gaj stream, Baner Khad and Chaki Nala.

6. The Sutlej River and its tributaries such as Karnali Gad, Kajo Gad and Kurpan River, Buddha Nala, and its canals with their Heads at Ropar, Ferozepore, Suleimanki and Panjnad.

7. Ghaggar, Jaiya, Markanda, Tangari, Sarusti and their tributaries in Ambala and Hissar Districts.

8. Right Bank of the Jumna River near Tajewala weir and its tributary Somb Nala, near Dadhupur; and the Western Jumna Canal near Dadhupur Regulator, which lie in the Punjab.

Fisheries in the Districts of Montgomery, Multan, Muzaffargarh, Jhang, Lyallpur, Mianwali, Shahpur and Sheikhupura are leased annually, while in all the other districts yearly individual licenses are issued for nets as well as for rod and line.

A fairly large collection of the food fishes of the Province has been made and observations on their habits and habitats have been recorded from various streams. Arranged according to their relative economic value the food fishes[2] of the Province may be included in the following families:—

1. *Cyprinidae* (Carps).
2. *Siluridae* (Cat-fishes).
3. *Ophiocephalidae* (Murrel).
4. *Salmonidae* (Trout).
5. *Notopteridae*.
6. *Rhynchobdellidae* (Spiny Eels).

The classification followed in this paper is that of Dr. Day, but the nomenclature of the fishes has been corrected according to the recent researches, and synonyms are given where necessary. Local names of the fishes, given here, vary in different localities.

Family: Cyprinidae.

Cyprinidae or Carps with scales on their bodies, one dorsal fin and without teeth in their jaws, are well-represented in all the rivers of the Punjab. They have wholesome, well-flavoured flesh, though bony, and are considered excellent food. Arranged according to their relative economic value the following genera represent the food fishes of the Province:—

1. *Labeo* (Cuvier).
2. *Barbus* (Cuvier and Valenciennes).

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[1] Hamid Khan, *The Punjab Fisheries Manual*, 1930.

[2] Coloured illustrations of some of these fishes appear in *Journ. Bomb. Nat. Hist. Soc.*, vol. xxxvi (1932), pp. 29-66, 'Game Fishes of Bombay' by Sir Reginald Spence and S. H. Prater.

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3. *Cirrhina* (Cuvier and Valenciennes).
4. *Catla* (Cuvier and Valenciennes).
5. *Aspidoparia* (Heckel), Bleeker.
6. *Barilius* (Ham. Buch.).
7. *Chela* (Ham. Buch.).
8. *Orelnus* (McClelland).
9. *Garra* (Ham. Buch.).
10. *Scaphiodon* (Heckel).

GENUS: LABEO.

Labeo rohita (*Vern. Pohu, Tapra, Dhambra*) occurs in all the rivers, streams and dhans of the Province in the plains and never goes up to the hills. It feeds on weeds and vegetation, and takes a bait of wheat flour mixed with spices. It is a very active fish. It is often seen jumping clean over the nets of fishermen with considerable force and velocity. It breeds during the monsoon, in July and August, and is a prolific breeder. A ripe female of 10 lbs. contained 1,905,000 ripe eggs. The egg measures 1·5 mm. and is non-floating. It swells to 3 or 4 times its size by the absorption of water by the vitelline membrane and hatches out in less than 30 hours. During the rainy season as soon as the streams are flooded, these fishes run up to shallow waters to spawn, and after laying their eggs they fall back into dhans or jhils or side streams, which, after the floods, are cut off from the main channel. From these dhans these fishes are caught in nets in large numbers.

It grows to 3′ or more in length, and is one of the best edible fish of the Province. Its flesh is wholesome and well-flavoured. It is good for stocking tanks. Common in the market.

Labeo gonius Ham. Buch. (*Vern. Seereha*), is another Carp of the plains, common in Sutlej and Beas rivers. It breeds during July and August, and is a prolific breeder. The egg measures 1·5 mm., is non-floating and swells to 3 times its size as soon as it sinks. It hatches out within 24 hours in a temperature ranging from 78°F. to 82°F. It grows to 2′ or more in length and is considered excellent food. It is good for stocking tanks. Common in the market.

Labeo calbasu Ham. Buch. (*Vern. Dhai, Kalahan, Kalbons, Di*), occurs in the plains only and is readily recognised by its blackish colouration. It spawns during July and August and is a prolific breeder. A ripe female, weighing 4 lbs., contained 739,400 eggs. It attains 2′ or more in length and is good eating. Common in the market.

Labeo diplostomus Heckel (*Vern. Gid*), occurs in the submontane streams, but never goes up to snow-fed streams, and is found in Mahseer waters of Kangra, Gurdaspur, Rawalpindi and Jhelum Districts. It breeds during the monsoon. It grows to 1′ or more in length and possesses wholesome but bony flesh; eaten by the local inhabitants.

Labeo microphthalmus Day (*Vern. Bhangan*), occurs in the plains as well as in the submontane streams. Its snout is smooth without any groove. It breeds in the rains, during July and August, is a prolific breeder. A single ripe female contained 6,105 eggs per lb. of its weight. It has bred successfully in the tanks and its fry often move in shoals. It grows to 18″ or more in length, is good eating but bony, and is consumed locally.

Labeo sindensis Day (*Vern. Gheri, Gher*) is another hill Carp, but comes down in the canals and is often caught in the plains. It is silvery in colour with a reddish tinge, and reddish fins. It grows to over 1′ in length, is good eating but bony. Consumed locally.

Labeo dyochilus McClell. (*Vern. Butal, Paratha, Dhai, Torki, Kunni*), also belongs to submontane streams and is often found in tanks fed by canals. It breeds during the rains, in July and August. It grows to 2′ or more in length, is considered excellent as food, and is eaten by the local inhabitants.

Labeo nigripinnis Day (*Vern. Kali* or *Bagi Machhi*), is found in Mahseer waters and is common in Attock, Rawalpindi and Jhelum Districts. It grows to over a foot in length and is eaten by the local inhabitants.

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GENUS: BARBUS.

Barbus tor Ham. Buch. (*Vern. Mahsir, Bhor, Chiniaru, Chitratu, Machh, Ghaur, Khakhiaru*) represents the Mahseer of sportsmen, and includes many different varieties in the Punjab. A collection is being made from different localities to ascertain their chief characteristics. The Mahseer occurs in all the hill tracts of the Punjab, but is not met with in snow fed streams where the temperature falls below 60°F. in summer. In the Beas it goes up to Mandi State, but so far has not been recorded from Kulu. Sanctuaries in Kangra are its favourite resorts and it frequently breeds there. During winter it travels down as far as Multan and Mozaffargarh, but as soon as the water gets warmer, it begins to ascend the hill streams.

Its sex organs and fry are being collected from various streams to study its breeding season. Fry of all sizes are found in abundance in the hill streams of Kangra, Gurdaspur, Rawalpindi, Attock, Jhelum and Hoshiarpur Districts; River Beas near Dera Gopipur (Kangra District); Ravi near Muktesar and Madhopur; River Chenab above Marala Head; River Jhelum above Rasul Head and at Tangrot; Chablat, Sohan and Kurang streams in Attock and Rawalpindi Districts are the best fishing streams and localities for Mahseer.

Barbus tor feeds on insects and aquatic vegetation. It takes artificial fly and spoon and likes wheat flour as well. In ponds and tanks attached to sacred places, they become easily domesticated and are fed on wheat flour. It is a very active fish and can leap over obstacles. It grows to 3′ or more in length and is said to reach 200 lbs. in weight.

Barbus hexastichus McClell. (*Vern. Lubar, Chitratu,* and *Barbus chilinoides* McClell. (*Vern. Chitratu*), resemble *Barbus tor* in general habits and are found in Mahseer waters. They have been caught from the River Ravi near Muktesar and from Kangra streams. They attain 2 or 3 feet in length, are considered excellent food, and are consumed locally.

Barbus sarana Ham. Buch. (*Vern. Kharni, Khangni, Kangrota, Karati,* 'Olive Carp') occurs in all the rivers and streams in the plains as well as in submontane streams. It is a prolific breeder and lays its spawn in shallow waters during the monsoon, in July and August. Ripe females have been easily stripped. The hatching takes place within 20 hours in water where the temperature ranges from 78°F. to 82°F. It grows to about a foot in length. It is good eating, but bony.

GENUS: CATLA.

Catla catla[1] Ham. Buch. (*Vern. Theila, Theil*) occurs in all the rivers and streams in the plains. It is a prolific breeder. A ripe female weighing about 10½ lbs. contained 400,275 ripe eggs. It spawns during the monsoon, in July and August, and its fry have often been found in shallow pits left after the floods have subsided. 'It is a very strong and active animal, and often leaps over the nets of fishermen with great force and velocity.'[2] It grows to 3 feet or more in length and has a very wide girth, hence the local name *Theila, Theil* (i.e. like a bag). It possesses rich, sweet and well-flavoured flesh and is not bony. 'The head is very fat and delicious and the flavour of the whole is excellent when the size is moderate . . . but when large it acquires a rank taste.'[3]

GENUS: CIRRHINA.

Cirrhina mrigala Ham. Buch. (*Vern. Mori, Morakha, Naraini, Mirgal*) occurs in all the rivers, streams and canals in the Punjab. It is a vegetable feeder, but has no objection to taking a bait of worms. It is a prolific breeder, and a ripe female weighing about 3¼ lb. contained 216,800 eggs. It spawns during the rains, in July and August. As soon as the streams, rivers and tanks are flooded by the first monsoon flood, the fish

[1] S. Raj, *Rec. Ind. Mus.*, vol. xii, 1916, p. 254.
[2] Ham. Buch., *Fish., Ganges*, 1822, p. 287.
[3] Hamid Khan, *Journ., Bomb. Nat. Hist. Soc.*, xxix, 1924, p. 258.

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run up the shallow water in flooded fields and side streams, females followed by males, play together, come in contact with each other, and the female lays its eggs while the male pours its milt at the same time. Very often the fishes have been heard to make a guttural sound, as if calling their mates. Since there is an immense waste of eggs and fry, Nature has provided these fishes with an enormous power of reproduction. The egg measures 1·5 mm., is non-floating and swells to 3 or 4 times its size as soon as it sinks. The hatching takes place within 24 hours in temperature ranging from 78°F. to 82°F. It breeds successfully in tanks and ponds if they are flooded during the rains. It grows from 8 to 10 inches in its first year, and reaches 14 inches in the second, becoming mature in its third year. It grows to 3 feet or more in length and is one of the commonest and the cheapest carp in the Province. It possesses white, well-flavoured flesh and is considered excellent eating.

Cirrhina reba Ham. Buch. (*Vern. Sunni*), is a smaller representative of the genus. It is common in all the rivers and streams and breeds during the monsoon. It is a prolific breeder, and a half-a-pound female contained 3,200 eggs. It attains a foot in length. It is eaten by the local inhabitants but is bony.

Genus: Crossochilus.

1889. *Cirrhina latia* Day, *Faun. Br. Ind. Fish*, p. 279.

Crossochilus latia[1] Ham. Buch. (*Vern. Taler, Golu, Dogru, Mura*) is common in all the hill streams of the Punjab and is found sticking to stones like a loach. It grows to hardly 8″ in length and is often caught in Kangra by means of *Kalerni*[2], a horse-hair noose. It is eaten by the local inhabitants.

Genus: Aspidoparia.

Aspidoparia morar Ham. Buch. (*Vern. Chilwa, Chal, Reta, Gachal*) or chilwa of the Punjab, occurs in almost all the rivers and is often seen jumping out of water in large numbers just below the canal weirs. It is migratory in its habits and runs up in shoals in March in search of its breeding grounds, and descends in October after spawning. In the Beas River, near Gurdaspur, where it is known as *Reta* or *Gachal*, it is caught in March and October by diversion of the water. When chilwa are running up stream in shoals, the fishermen select side stream and stop it both up and down stream during the night. A screen made of reeds, known as *chipli*, which allows the water to run through, but stops the fish, is placed in the lower bund. The water is then diverted into a new channel just before dawn. The water between the bunds is drained off and the stranded fish are collected in large quantities.

Aspidoparia morar breeds in April and May. A female caught on 31st March contained fully ripe eggs. It reaches 6 or 7 inches in length and is used as bait. Its bones are soft and it is fried whole. Its flesh is rich, wholesome and well-flavoured and it is said to possess nourishing and invigorating qualities. It is consumed locally.

Genus: Barilius.

Barilius vagra Ham. Buch. (*Vern. Chilwa, Chal, Lohari*) occurs in the hills as well as in the plains and is also called *Chilwa*. It is migratory in habit and has been caught in all the rivers and canals. It attains 5″ or more in length. It is very rarely caught by the fishermen, as the regulated mesh of their nets is 1½ inches square or 6 inches all round and such small fishes escape through it. It is good eating.

Barilius bendelisis Ham. Buch. (*Vern. Chilwa, Chal*) resembles *B. vagra* in its habits and attains 6 inches or more in length. It is good eating.

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[1] Vinciguerra, *Amer. Mus. Stor. Nat. Genova*, xxix, p. 246, pl. vii, fig. 4, and Hora, *Rec. Ind. Mus.*, xxii, p. 183.

[2] Hora, S. L., *Journ., Proc. As. Soc. Beng.* (*New series*), Vol. xxii, 1926, No. 1, pp. 81-84.

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GENUS: CHELA.

Chela gora Ham. Buch. (*Vern. Chilwa, Chal*) is another Chilwa of the Punjab. It possesses a long, flat, silvery body, with cutting abdomen, up-turned mouth and concave lateral line. It occurs in all the streams and is very often near the canal weirs. It moves in shoals and is migratory. It attains 9 or 10 inches in length, is used as bait and is good eating when fried. It is seldom caught by the fishermen as it passes through the mesh of their nets. It rises to fly.

Chela bacaila Ham. Buch. (also *Chilwa, Chal* or *Parranda*) occurs in all the streams. It reaches 7″ or more in length, and is used as a bait. It is good eating.

GENUS: OREINUS.

Orienus sinuatus[1] Heckel. (*Vern. Gulguli, Saloh, Galda, Slaon*) or Himalayan barbel is one of the hill carps possessing very minute scales. It is the only indigenous fish that occurs in the Kulu Valley and is found in the Beas River as far down as Mirthal where the hills end. Further down in the plains no one knows it. During winter in Kulu, it is not found in waters eblow 50°F. In the Ravi River it comes up to Madhopur and very often goes down the canal as far as Dhariwal. Its mouth is inferior and the lower lip is well-developed and forms an adhesive sucker to enable the fish to adhere to rocks and live in rapid hill streams. Ripe females have been caught from April to October, which is its breeding period, and fry seen with yolk sac from April to December. In the last week of April newly hatched alevins have been found in a spring in Kulu, and in November a ripe male has been caught. In August a ripe female caught in Fojal Nal in Kulu in temperature 60° F. yielded eggs quite easily. Eggs measure 2 mm. or 11 to the inch, and when left in water they swell to the size of 5 mm. A 2½ lbs. female, 17″ in length contained about 15,000 eggs.

Orienus sinuatus creeps over stones, eating the green vegetation which covers them and also the small cadis larvae which are attached to them. It takes a worm in clean water, and is said to like mulberries. It grows to at least 2′ in length. It is good eating, but bony. 'It is too rich for some people, but does not deleteriously affect those used to it.

GENUS: GARRA.

1919. *Discognathus jerdoni* Var. *kangrae* Annandale, *Rec. Ind. Mus.* xviii, p. 74. *Garra gotyla*[2] Gray (*Vern. Kurka, Dhogun*) is a hill carp and occurs in abundance in the Kangra hill streams. It possesses a suctorial disc on the chin, formed on the lip, which enables it to adhere to rocks. It attains at least 8″ in length and is often caught by a horse-hair noose (*Kalerni*) in Kangra. It is eaten by the local inhabitants.

1872. *Discognathus lamta* Day, *Journ. As. Soc. Beng.* xli (2), p. 318.

Garra monti-salsi[3] Hora, occurs in the streams of the Salt Range, Punjab, and has been collected from Choa Saidan Shah streams. It is eaten by the local inhabitants.

GENUS: SCAPHIODON.

Scaphiodon readingi[4] Hora, occurs in the Salt Range streams and is common in Choa Saidan Shah. In the adult, the colour is dark-grey above, yellowish underneath. The young ones are golden yellow in colour with indistinct dark bands on the dorsal surface. In many specimens, the snout, anal fin, and posterior sides of the body are covered with a regular series of tubercles which are of parasitic origin.[5] Ripe males and females have been caught in April and June. It reaches at least 1′ in length and is eaten by the local inhabitants.

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[1] Day, F., *Faun. Br. Ind. Fish*, i, p. 249.
[2] Hora, S. L., *Rec. Ind. Mus.*, xxii, 1921, p. 653.
[3] Hora, S. L., *Rec. Ind. Mus.*, xxv, p. 378.
[4] Hora, S. L., *Rec. Ind. Mus.*, xxv, p. 397, pl. viii.
[5] Prashad, *Rec. Ind. Mus.*, xviii, p. 160 (1920).

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FAMILY: SILURIDAE.

Siluridae in the Punjab are all scaleless and are known as Cat-fishes. They have one to four pairs of barbels. They prefer muddy to clean waters, and are all carnivorous, having teeth in their jaws and palate. They also possess strong dorsal and pectoral spines, which are usually serrated or toothed, and often cause poisonous or irritating wounds if handled carelessly. *Siluridae* of the hills are small in size and often possess an adhesive apparatus on throat and chest to enable them to adhere to rocks.

Siluridae in general are not considered 'to be very wholesome,[1] either being too rich or too hard and indigestible, whilst their flavour is inspid.' The small branched intermuscular bones present in *Cyprinidae*, are absent in *Siluridae*. They are common in all the rivers and streams of the Punjab, and some of the species in the plains reach a large size. On account of their cheapness they are much in demand by the local inhabitants. Arranged according to their relative economic importance they include the following edible genera:—

1. *Rita* (Bleeker).
2. *Wallago* (Bleeker).
3. *Ooria* (Jordan).[2]
4. *Pseudeutropius* (Bleeker).
5. *Eutropiichthys* (Bleeker).
6. *Callichrous* (Ham. Buch.).
7. *Silundia* (Cuv. & Valen.).
8. *Blyptothorax* (Blyth).[3]
9. *Saccobranchus* (Cuv. & Valenc.).
10. *Sisor* (Ham. Buch.).

GENUS: RITA.

1889. *Rita buchanani* Day, *Faun. Br. Ind. Fish*, i, p. 165.

Rita rita Ham. Buch. (*Vern. Khakka, Trikunda*) occurs in all the rivers and streams. It has three strong spines and is thus locally known as *trikunda* (three-spined). It is very tenacious of life and can be carried alive to long distances wrapped in a moist cloth. It makes a quaking or grating sound by the movements of its strong pectoral spines in their sockets, while a guttural sound is produced if the ventral surface of the living fish is pressed. This is due to the air in the air-bladder being pressed out through the mouth and gill clefts. This can be verified if the fish is put under water and its ventral surface pressed, air bubbles issue from the mouth and from underneath the operculum. They prefer muddy to clear water and possess six long barbels, which they employ in moving about, and consequently have less use for their eyes, which are comparatively very small in the adult. One specimen, caught from River Ravi, near Lahore, was healthy in all respects but totally blind. During winter they conceal their heads in crevices of stones or fallen trees and are often caught by divers, who catch them firmly between their three spines and do not permit them to move. When annoyed they raise their spines and often inflict ugly wounds.

Rita rita is carnivorous and feeds mostly on insects, their larvae and on young fishes. It also feeds even on carrion. It takes live bait, worms, chilwa or raw meat. Ripe females have been caught in June and July and successfully stripped. Many males caught from the River Jhelum (temperature 62°F. to 68°F.) were spent up in June. Testes are branched, comb-like, and are full of milt. During the breeding season which lasts from June to the end of July, it migrates to colder waters and moves in shoals. It is a prolific breeder, a ripe female weighing 1 lb. contained 3,000 eggs.

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[1] Day, F., *Rept. Fish and Fisheries, Fresh Water, Ind.* 1871, p. 47.

[2] Jordan, D. S., *Genera of Fishes*, iv, p. 567 (1919).

[3] Blyth, *Journ., As. Soc. Beng.*, xxix, 1860, pp. 153, 155, and Hora, *Rec. Ind. Mus.*, xxiv, 1922, p. 33.

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It attains 3′ or more in length, though the specimens commonly obtained are 1-2′ in length. It is very common in the River Ravi and its tributaries. The flesh is rich and firm and its soup is said to possess nourishing and invigorating qualities. It is to be avoided in places where it is a foul feeder.

Genus: Wallago.

Wallago attu Blotch & Schneid. (*Vern. Mulee*) is one of the so-called 'Fresh-water Sharks' of the Punjab. It has an elongate body, deeply cleft mouth, extending behind the eyes, and formidable rows of teeth in the jaws and vomer, and bites viciously if handled carelessly. It inhabits both fast and sluggish waters, and is common in all the rivers and tanks. It is not only carnivorous, feeding on fishes, their eggs and fry, but a voracious and foul feeder devouring carcasses. It is considered to be one of the scavengers of the rivers and feeds both during day and night. Just below the canal weirs, where chilwa abound it may be seen chasing them all day long. Near Ropar (River Sutlej) a family of professional fishermen gave up their profession as they found in the stomach of a *Mulee* the arm of a child, which they recognised by the gold bangle on it to be the arm of their own child, the body of which they had thrown in the river the previous day. Seshachar and Das[1] record a nearly fully grown mud snake, *Cerberus rhynchops*, inside the stomach of a 22-22·75″ long *Wallago attu*, obtained from Calcutta market. The snake measured 25″ in length and 1.5″ in girth.

The spawning season of *Wallago attu* lasts from July to August. As soon as the streams or tanks are flooded by rains, they run up the shallow waters and lay their spawn. Ripe females are easily stripped. Eggs are yellowish in colour and each measures 1.5 mm. As soon as they sink in water they swell to double their size. Embryo differentiates in less than 12 hours and hatches out in from 14 to 24 hours, depending upon the temperature of the water. A newly hatched embryo possesses a long yolk sac, and shows lobular projections at the antero-ventral end of the head, which grow to form the barbels. The yolk sac is soon absorbed and the fry wander about, attack each other and begin to prey upon the eggs and fry of other fishes.

Wallago attu grows to 6 feet or more in length. It thrives in tanks but its culture is to be avoided on account of its carnivorous habits. It takes live bait, worms, chilwa or raw meat. Its flesh is not well-flavoured but on account of its cheapness and the absence of tiny bones, it is very much in demand in the Province and is eaten cooked or fried.

Genus: Aoria.

1889. *Macrones seenghala* Day, *Faun. Br. Ind.* i, p. 150.

Aoria seenghala Sykes. (*Vern. Chaija, Singoa, Singharee, Seengala*) occurs in all the streams and rivers and flourishes in tanks as well. Its maxillary barbels extend to the middle or just beyond the hind margin of the dorsal fin, while in *Aoria aor* (Ham. Buch.) they are much longer and reach the base of the caudal fin. It breeds during June and July. Ripe females have been caught in June. It is carnivorous and feeds on eggs and fry of other fishes. It grows to 3 feet or more in length, while *Aoria aor* is said to attain 6 feet in length. Its flesh is firm and sweet, but decomposes rapidly if kept long without being salted. Considered excellent food. Common in the market.

Aoria cavasius Ham. Buch. (*Vern. Tingara*), and *Aoria tengara*, Ham. Buch. (*Vern. Kingar* or *Tingara*) are smaller varieties. The former[2] is said to attain 18″ though the specimens caught measure 6 to 8 inches, and the latter 4 or 5″ in length. They are common in submontane streams and are eaten by the local inhabitants. In a specimen of *Aoria tengara*, caught in the River Ravi near Madhopur, the maxillary barbels reach beyond the anal fin and the adipose fin commences immediately behind the first dorsal.

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[1] B. R. Seshachar and B. K. Das, *Proc. 18th Indian Sc. Cong.* 1931, p. 229.
[2] Day, F., *Faun. Br. Ind. Fish*, i, pp. 155-156.

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GENUS: PSEUDEUTROPIUS.

Pseudeutropius garua Ham. Buch. (*Vern. Bachwa, Dhuan, Dhunga, Baikiri, Karad*) or Bachwa occurs in all the rivers of the Province. It is migratory in habits, and its movements have now become restricted owing to the erection of the canal weirs. Only a few years ago numerous *Bachwa* could be seen in the River Jhelum just below the Rasul Head Works, but now their number is considerably reduced. It is common in the River Jhelum above Rasul Head and in the River Sutlej near Ferozepur and Ropar. It is caught on long line or rod and line from March till the end of October. Ripe males and females have been caught from June till the beginning of August. Mature females can easily be stripped. The testes, comb-like and swollen with milt yield their contents with slight pressure. During the breeding season from March, they ascend the cold waters to spawn in a temperature ranging from 62°F. to 68°F. in the River Jhelum. They move in shoals and lay their eggs in shallow parts of the main stream. It is at this time that they are caught and killed in large numbers. *Bachwa* are carnivorous and feed on insects and their larvae, crustaceans and small fishes. In clear waters they take a fly or a small spoon and in muddy and flooded waters, especially from May to August, worms, pieces of raw liver or clotted blood from an excellent bait. Dorsal and pectoral spines often cause severe wounds if handled carelessly. It grows to 2′ or more in length. The adipose fin is absent in the adult. One of the best food fishes of the Province. Possesses wholesome and well-flavoured flesh and is without any intramuscular bones. *Bachwa* is common in the markets of Ferozepore and Jhelum in the months of March to August.

Pseudeutropius murius Ham. Buch. (*Vern. Pahari, Bachwa, Gulgul, Karad*) possesses an adipose fin throughout its life. There are 8 barbels and their length is generally variable and differs from that given by Day.[1] The nasal ones reach a distance behind the posterior edge of the orbit, the maxillary reach the commencement of the ventral or extend to a short distance beyond the end of the pectoral. Mandibulars are as long as, or a little shorter than, the head. It occurs in the submontane parts of the river, and is common in the River Jhelum above Rasul Head and in the River Sutlej near Ropar, and in canals as well. It is migratory and moves in shoals. It ripens earlier than *Pseudeutropius garua*, and ripe females have been stripped successfully in June. Many females caught in the beginning of July were spent. The temperature of water, where they spawn, ranges from 62°F. to 68°F. It is carnivorous and feeds on insects and their larvae and on small fishes. Takes worm, chilwa, piece of raw liver or clotted blood as a bait. It reaches one foot or more in length, and one of the largest female specimens, caught in the River Jhelum, measured 12·8″. Its flesh is rich, wholesome and well-flavoured.

GENUS: EUTROPIICHTHYS.

Eutropiichthys vacha Ham. Buch. (*Vern. Jhalli, Challi, Bachwa, Barain, Dhungan, Dhuan, Baikiri, Baiki*) is another Bachwa. It has got a pointed snout and the cleft of the mouth extends to the posterior margin of the orbit. There are 8 barbels. The nasal barbels extend a short distance beyond the posterior margin of the orbit, the maxillary reach the middle of the preoperculum and the mandibular extend upto or a little behind the cleft of the mouth. It occurs in all the streams and is migratory. It moves in shoals. Its favourite resorts are the River Sutlej near Ropal, Ferozepore, and the River Beas near Talwara, Mirthal and Naushera. It is carnivorous, lives on insects, their larvae and on small fishes. It takes a 2′ spoon, clotted blood, raw liver and raw meat. It attains a foot or more in length and is considered excellent eating.

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[1] Day, F., *Faun. Br. Ind. Fish*, i, pp. 139-140.

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GENUS: CALLICHROUS.

Callichrous bimaculatus Blotch (*Vern. Pallu, Pafta.* 'Butter Fish') occurs in all streams and is common in tanks. It has no adipose fin and possesses a long anal fin. It feeds mostly on insects and their larvae. Ripe females have been caught in August. It breeds during the rains, in July and August. It reaches a foot and a half in length. It is considered excellent eating and is one of the so-called Butter Fish.

Callichrous pabda Ham. Buch. is a smaller species, reaching 8 or 9″ in length. It is good eating, but females with ripe eggs are to be avoided during their breeding months, July and August, as they produce nausea when eaten.

GENUS: SILUNDIA.

Silundia gangetica Ham. Buch. (*Vern. Silund*) is another fresh-water shark and a scavenger of the rivers. It occurs in Jumna, near Tajewala weir, and has not so far been recorded from any river in the Northern Punjab. It is carnivorous and voracious. It grows to 6′ in length. The flesh is not wholesome, but owing to its cheapness and absence of intramuscular bones, it is much in demand locally.

GENUS: GLYPTOTHORAX.

Glyptothorax pectinopterum McClell. (*Vern. Mochi, Nao, Nai, Dhobia, Juppah, Nungrari, Kuggar, Pahari, Khagga*) is a hill Cat-fish with horse-shoe-shaped adhesive apparatus on the chest which enables it to adhere to rocks. It occurs in the hill streams of Kangra, Gurdaspur and Jhelum districts and often gets down the canals. It is less than a foot in length and is eaten by the local inhabitants.

Glyptothorax coniostre Steind. is another *mochi* or 'Cobber fish' differing from *G. pectinopterum* in having a wider mouth, a narrow head, broader barbels, and more elongated and adhesive apparatus. It occurs in Kangra and other hill streams. It reaches 8 or 9′ in length and is eaten by the local inhabitants.

GENUS: SACCOBRANCHUS.

Saccobranchus fossilis Bloch. (*Vern. Singhi, Naulahi, Naulakhi*) is the much-dreaded 'Scorpion Fish', and occurs generally in sluggish waters, streams and tanks. 'It possesses accessory respiratory chambers in the shape of long air sacs, with vascular walls, lying internally to the trunk muscles and passing backwards close to the vertebral column.'[1] They are visible if the fish is dissected from the dorsal surface.

'Wounds from its pectoral spines are poisonous, cause fever and inflammation'.[2] Immersion of the fisherman's hand, when the wound had been caused, into 10 per cent formalin for a quarter of an hour gave great relief and checked the inflammation. The fish is killed and the spine broken before it is removed from the net. It breeds during the rains. The colour of the eggs is pea-green. They fry are of reddish colour. The fish grows to 1′ or more in length. Its flesh is said to possess invigorating qualities. But in the Punjab, these fishes are as much dreaded as snakes and are eaten by the poor and low caste people only.

GENUS: SISOR.

Sisor rhabdophorus Ham. Buch. (*Vern. Kirrla, Kirrlu*) as one of the Cat-fishes with osseous plates on the back. Its adipose fin is represented as a short spine, with upper caudal ray elongated into a caudal filament. It attains about 8″ in length excluding the caudal filament, and has been caught from the River Sutlej near Ropar, Deg Nala, and from streams in the Gurdaspur district. It is seldom eaten, but it is said to possess nourishing and medicinal qualities.

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[1] Day, F., *Fish. Ind.*, ii, 1878, p. 439.
[2] Day, F., *Faun. Br. Ind. Fish*, i, 1889, p. 126.

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FAMILY: OPHIOCEPHALIDAE.

GENUS: OPHIOCEPHALUS.

Ophiocephalus marulius Ham. Buch. (*Vern. Saul*) is one of the snake-headed mud fish. It occurs in all the rivers and streams, prefers sluggish to swift running water, and is common in tanks. It is carnivorous and has fine pointed teeth in the jaws, vomer and palate. It lives mostly on small fishes, frogs and tadpoles. It possesses a respiratory chamber in the head. When the tanks or ponds become dry it burrows under the mud and remains there till fresh water releases it from its confinement. It is monogamous. During the spawning season, which lasts from April to June, a male and female make, near the bank, a floating nest of weeds or grass cut with the mouth. Spawning has successfully taken place in the Departmental tanks at Madhopur and Chhanawan. The reddish yellow eggs float and lie in the 'nest'. Each egg measures 2 mm. and a single large oil globule in the yolk makes each egg buoyant. The embryonic development goes on rapidly, but depends considerably on the temperature of water. The eggs hatch out in 54 hours in a temperature of 61°F. to 79°F., and in 30 hours in 83°F. to 92°F. The nest is guarded by the parents, and after a week or so the fry are taken out from the nest in the company of the parents, which guard them zealously for about six weeks. The fry swim together and frequently come to the surface leaving air bubbles, and are easily distinguishable by their bluish-black ground colouration. As soon as the fry begin to leave their parents and wander about, the parent fish themselves begin to devour them, and those which escape continue the progeny.

The colour of the adult varies with its environment. It is dark dirty green above, sides yellowish green, belly bluish white. There are 6 to 7 distinct black blotches over the lateral line with numerous pearly white spots. Pearly white spots are also present on the sides above the lateral line, and on the dorsal, caudal and anal fins. Fins dark grey. There is a large black ocellus with white margin at upper part of base of caudal fin. The ocellus[1] appears in fry ranging from 70 mm. to 90 mm. in length, age 7 weeks to 11 weeks, and remains distinct till the second year, when the fish reaches 15-18″ in length. Afterwards it becomes indistinct and is lost in the dark colour of the caudal fin. It grows to 4′ in length. Flesh firm, white and flaky, without any intramuscular bones, and with a wholesome agreeable flavour. It is considered excellent food.

Ophiocephalus striatus Bloch. (*Vern. Saul Daula*) occurs in sluggish streams and tanks and has bred successfully in ponds. It breeds from April to June and only once a year. It builds a nest or a receptacle near the banks and both parents mount guard. The fry move in groups, followed by the parents, and come to the surface to exhale air bubbles and are easily distinguishable by their soft reddish brown colour. In the adult there are bands of grey on the sides of the abdomen. It grows to 3′ or more in length and is considered excellent food.

Ophiocephalus punctatus Bloch. (*Vern. Daula, Karrar, Dalunga*) occurs in all the rivers, streams, borrow pits, ditches and tanks. It burrows in mud and prefers stagnant and muddy to running water. It is carnivorous. Breeds once in the year, from April to June. It lays its floating eggs in a rude receptacle along the banks and guards its nest and fry. Ground colour of fry black and yellow. Often come to the surface to exhale air bubbles. It grows to a foot or more in length and is eaten by the local inhabitants but is bony.

Ophiocephalus gachua Ham. Buch. (*Vern. Dauli, Dhaunku*) is found in all the rivers, tanks, ditches and borrow-pits. Burrows under the mud in ponds which dry completely in summer, where it remains concealed till the rains release it from its captivity. It is very tenacious of life and has been kept alive out of water, and even carried long distances, for considerable lengths of time. It is carnivorous and destroys eggs and fry of other fishes. It is

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[1] Hamid Khan, *Journ. Bomb. Nat. Hist. Soc.*, xxx, 1925, p. 534.

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monogamous and breeds from April to June. When spawning[1] the pair lie submerged in clear but sluggish water without any nest or receptacle. The female turns upside down and the male lies above it crosswise, so that their genital pores are in close contact. Two or three hundred eggs are liberated at intervals of a minute or so, and the fish remain in the same position and at the same place till all the eggs have been laid. The male pours its milt at the same time. Eggs are floating. They rise to the surface of the water and spread there. The fish use their fins all the time to keep their balance. The eggs yellowish in colour, measure 1·5 mm. in diameter. The eggs and fry are guarded by the parents. The fry frequently come to the surface and are easily distinguishable by their yellowish brown ground colour. Ocellus with light edge on the dorsal fin mentioned by Day[2] is present in specimens of 1½ inch to 2 inches) in length. It attains a foot or more in length. It is eaten by the local inhabitants, but is bony. Its soup is nourishing.

FAMILY: SALMONIDAE.

GENUS: SALMO.

Salmo fario[3] Linnaeus, or Brown Trout was introduced into the Punjab from Kashmir in 1909 in the form of eyed ova and were hatched in Kulu. From small beginnings the culture of trout has progressed satisfactorily and wild trout are now breeding in many streams in the hills. The Brown Trout thrives in clear, cold, rapid, snow-fed streams. It is active in its habits and leaps over obstructions. It feeds on insects and on their larvae, worms, molluscs and small fishes. In hatcheries they are fed on slugs, snails, worms, minced meat, goat liver and fresh fish mixed with wheat or maize flour. Spawning begins in November and continues till February. The eggs measuring 4 to 6 mm. in diameter, are yellowish or reddish in colour. They are deposited at intervals in crude nests excavated by spawning fish and covered over with gravel. In the Department Hatcheries at Mahili (Kulu) fish are stripped from November to February as they ripen and ova after being fertilized are placed in trays in ova sheds. It takes 2 to 7 weeks, depending upon the temperature of water, for the eyes to appear. These eyed ova are quite hardy and can be moved without danger and sent to far off places. After 6 weeks more, the eggs are hatched out and 4 weeks later the fish begin to feed. By May and June the fry are collected from rearing ponds, taken in carriers and let into streams. Over a lac of fry are planted annually in the Beas and its branches in Kulu. Rivers and streams in the Punjab stocked with Brown Trout include

1. Ravi River in Chamba.
2. Beas River in Kulu and its branches.
3. Uhl River in Mandi State.
4. Baner and Gaj streams in Kangra and various other streams in Simla Hills.

Brown Trout in the Punjab have been reported to have reached 16 lbs. in weight.[4] The biggest hen fish in the pond near Srinagar (Kashmir), which was probably the mother of the first ova that came to Kulu weighed, when dead, 16 lbs. 1 oz. Brown Trout are one of the finest game fish, take artificial and natural fly and worms. Its flesh, wholesome and well-flavoured, without any intramuscular bones, is considered excellent eating. Its sale is confined to Kulu Valley only.

Salmo chasta[5] Jordan is *Salmo irridens* or Rainbow Trout of most writers and especially of fish culturists. It is, however, not *Salmo iridens*[6] (Gibbons),

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[1] Hamid Khan, *Journ. Bomb. Nat. Hist. Soc.*, xxix, 1924, p. 961.
[2] Day, F., *Faun. Br. Ind. Fish*, ii, p. 364.
[3] Howell, G. C. L., *Journ., Bomb. Nat. Hist. Soc.*, xxiv, 1915, p. 317.
[4] Mitchel, F. J., *Journ., Bomb. Nat. Hist. Soc.*, xxiv, 1915, p. 371.
[5] Jordan, Evermann and Clark, *Rept. U.S. Comm.*, 1928. B.F. 1055, p. 58 and Jordan, D. S., *Fishes*, 1925, pp. 320, 321, figs. 230 and 231.
[6] Gibbons, *Proc. Calif. Aceda. Nat. Sci.*, i, 1855.

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which is based on coastwise specimens. Five thousand Rainbow Trout ova were imported from Kashmir in 1920, but only 992 arrived to hatch out in Kulu. Out of these only 57 fry survived in the Hatcheries. In 1922 they came into season and were stripped, but the results were not satisfactory. The temperature of water in Kulu ranges from 33°F. to 38°F. in winter and 58°F. in summer, and it appears to have proved unfavourable for Rainbow Trout, which in their natural conditions are usually found in waters varying from 38°F. in winter to 70°F. in summer. They can live in water with comparatively higher temperature if it is plentiful and running with a strong current, and are found in swift running streams.

The Rainbow Trout breeds from January to February and lays its eggs in round or elongate nests, made on gravelly bottoms by the parents. The eggs sink into the nests and lie there protected until hatched. In the Departmental Hatcheries the fish are stripped from January till the middle of March. In May and June the fry are carried in tin carriers and put in the streams. Streams so far stocked in the Punjab are:

1. Beas in Kulu and its tributaries.
2. Luni Khad, Gaj, Baner and Binun streams in Kangara.

Rainbow Trout is a superior game fish and has wholesome, well flavoured flesh and is esteemed excellent as food.

FAMILY: NOTOPTERIDAE.

GENUS: NOTOPTERUS.

Notopterus chitala Ham. Buch. (*Vern. Pari, But, Moh*) occurs in all the streams, rivers and tanks in the plains. It has a laterally compressed body, and often swims on its side. It is carnivorous with teeth in jaws, vomer, palate and on the tongue as well. Ripe females have been caught in June. They breed in June and July. Eggs measure 3 mm. to 4 mm. each and are glutinous,[1] and adhere to objects on which they are deposited and are fertilized by the male at the same time. During the laying and hatching the parent fish is said to guard its nest. It is said to grow to 3′ in length. 'The belly is uncommonly rich and well flavoured but the back contains numerous small bones, and a strong prejudice exists against this fish as food, owing to its being supposed to live on human carcases.'[2] In the Punjab, however, there is no objection to the eating of this fish. It is not very common in the market.

Notopterus[3] *notopterus* Pallas grows to 2′ and occurs in all the rivers and streams in the plains. Its belly is eaten, the dorsal portion is bony.

FAMILY: RHYNCHOBDELLIDAE.

GENUS: MASTACEMBELUS.

Mastacembelus armatus Lacep. (*Vern. Bam, Groj, Sample Machhi*) is regarded as one of the local Eels with spines on the back. It has a long cylindrical body and is very slippery. It occurs in all the rivers and tanks. It is carnivorous and has minute teeth in the jaws and is very destructive to eggs and fry of other fish. In the adult, the colour is brown above and yellowish on the abdomen. In the young there are three black bands passing from the eye backwards. The black band in the middle is on the lateral line. It is broad and becomes wavy posteriorly. It attains 2′ or more in length. Specimen caught from Chhanawan Fish Farm measures 27·7″ in length. In the Punjab, these spiny eels are considered to be as repulsive as snakes and are eaten only by low caste and poor people. The flesh is firm and tough and is said to be heating and invigorating.

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[1] Southwell and Prashad, *Rec. Ind. Mus.*, xvi, 1919, p. 217.
[2] Hamilton-Buchanan, *Fish, Ganges*, 1822, p. 382.
[3] Pallas, *Spicil. Zool.*, vii, 1769, p. 40; Weber, *Fishes, Indo-Austr. Arch.*, iii, 1913, p. 9; Annandale, *Rec. Ind. Mus.*, xiv, 1918, p. 53.

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Mastacembelus pancalus Ham. Buch. is a smaller variety of spiny eel, attaining 7 inches in length and is occasionally caught on rod and line, and does not form an article of food.

GENUS: RHYNCHOBDELLA.

Rhynchobdella aculeata[1] Bloch. is another representative of this family. Only two specimens have so far been obtained from the River Sutlej measuring 151 mm. and 116 mm. respectively. There are four well defined ocelli having a white edge at the base of the soft dorsal.

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[1] Day, F., *Faun. Br. Ind. Fish*, ii, p. 331.

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NOTES ON COORG BUTTERFLIES.

BY

LT.-COL. W. M. LOGAN HOME.

It may be of interest to members of the Society who collect butterflies to know of my experiences in Coorg during the season 1932-33.

The monsoon that year was distributed over a longer period than usual, in fact the S.-W. Monsoon was merged into the N.-E., so that rain continued into November, which undoubtedly had an effect on the appearance of butterflies. The usual post-monsoon hatch out was very much smaller than usual, some species appeared off and on throughout the period in markedly smaller numbers, while many species were conspicuous by their absence. Others, recorded by Yates as appearing in September-October, were not seen till the end of December to February. I have followed J. A. Yates' list in the order and naming he gives in vol. xxxiv, No. 4, and vol. xxxv, No. 1, to make comparison easy. (Many of the names and numbers have since been altered in Evans' latest edition.)

The district worked out was practically the whole of Coorg with the exception of the Tittimatti area and the Brahmagiris.

The period was from July 1932 to February 1933.

The species can be conveniently divided into 4 groups.

1. Those seen or caught throughout the period.
2. Those seen or caught between July and October, mostly W.S.F.
3. Those seen or caught between November and February, mostly D.S.F.
4. Those not seen at all.

Group I.—Those seen and caught throughout the year.

A. PAPILIONIDAE.

A. 2. 10β. **Byasa a. aristolochiae.**
A. 4. 19 β. **Papilio selenus daksha.**
A. 4. 25α. **Papilio polytes romulus.**
A. 6. 2α. **Zetides sarpedon teredon.**
A. 6. 3β. **Zetides doson eleius.**
A. 6. 8α. **Zetides agamemnon menides.**

B. PIERIDAE.

B. 1. α. **Leptosia nina nina.**
B. 6. 2. **Delias eucharis.**
B. 11. 1. **Catopsilia** { **crocale.**
11. 2. { **pomona** Not as common as crocale.
11. 4. { **pyranthe** nina.
11. 5. { **florella.** Not as common as pyranthe.
B. 19. β. **H. glaucippe australis.**
B. 15. **Terias.** { **libythea, blanda silhetana.**
v. venata, hecabe simulata.

C. DANAIDAE.

C. 2. 1α. **D. a. aglea.**
2. 7. **D. limniace.**
2. 12. **D. plexippus.**
2. 14. **D. chrysippus.**

D. SATYRIDAE.

D. 2. 9α. **Mycalesis p. typhlus** { W.S.F. from August to November.
,, **m. polydecta** { D.S.F. from November to February.
D. 22. 1. **Melanitis leda ismene.**
D. 24. **Parantirrhoea marshalli.** Rare. A few seen here and there in the 'wate' from August to February. Only 3 taken.

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F. Nymphalidae.

F. 18. 3.*a*. **Euthalia lepidea miyana.**
Urti Ghat.
F. 26. 6. *a*. **Neptis hylas varmona**
26. 3. 2. β. **Neptis hordonia.**
30. 1. **Hypolimnas misippus.**
2. **Hypolimnas bolina.**
F. 35. 6. **Precis ephita pluviatis.** Common all over the ghats.
F. 41. β. **Cupha erymanthis maja.**
49. 1. *a*. **Ergolis ariadne indica.**
2β. **Ergolis m. merione.**

H. Lycaenidae.

H. 14. 1*a*. **Castalius rosimon.** Not common.
H. 15. 2. **Tarucus theophrastus nara.** Not common.
H. 75. **Cheritra freja jaffra.**

I. Hesperidae.

I. 1. 6. **Badamia exclamationis.**
I. 20. 4. β. **Tagiades obscurus athos.**
I. 20. 9. **Tagiades litigiosa vajuna.**
I. 25. **Coladenia indrani indra.**
I. 26. 3.β. **Sarangesa d. davidsoni.**
1. 58. 5*a*. **Acromachus pygmaeus.**
I. 61. 2*a*. **Iambrix salsala luteipalpus.**
I. 67. **Sancus pulligo subfasciatus.**
I. 105. 4. **Taractrocera c. ceramas.**

Group II.—Those seen and caught between July and October only (during the rains).

A. Papilionidae.

A. 1. **Troides minos.** Plentiful from July to October, after which it disappeared.
A. 2. 8 β **Byasa jophon pandiyana.** Scarce. Only seen and caught during July to August, all those seen only flew in dull or actually rainy weather.
A. 2. 9. **Byasa hector.** Plentiful from July to October. It disappeared, like T. minos, after October.
A. 4. 1β. **Papilio p. polymnestor.** Plentiful.
A. 4. 10*a*. **P. paris tamilana.** Plentiful. None seen after October.
A. 4. 14. **P. buddha.** Not uncommon, mostly low down.
A. 4. 16. **P. dravidarum.** Scarce. Only one caught. This species appeared for a very short period, end July to August.
A. 4. 26*a*. **P. d. liomedon.** Scarce. Only one caught and very few seen.

C. Danaidae.

C. 1. 1.β. **Hestia l. malabarica.** Not uncommon from Urti upwards.

D. Satyridae.

D. 15. 1. **Zipoetis saitis.** Not uncommon in 'wate', not seen after October.
D. 25. 1*a*. **Elymnias h. caudata.** Scarce, a few seen and caught in August to September; low down.

F. Amathusiidae.

F. 20. β. **Parthenos s. virens.** Not uncommon from August to October after which it disappeared.
F.24. 7β. **Limenitis procris undifragus.** Well distributed all over the ghats, but nowhere common. A difficult species to catch.

H. Hesperiidae.

H. 105. 2β. **Taractrocera m. flaccus.** Very rare, only one seen and caught on 15-9-32.

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Group III.—Those species seen and caught between October to February; after the rains.

A. Papilionidae.

A. 3. 5 β. **Chilasa clytia clytia** ♀ **v. dissimilis.** Scarce, a few seen, mostly dissimilar, low down on ghats.

A. 4. 27α. **Papilio d. demoleus.** Common.

A. 5. 6 β. **Pathysa antiphates naira.** Very scarce. 5 seen and all caught, sitting among myriads of *Appias a. darada* at edge of river at Maukut, on 22-1-33, none seen previously to this date, though I had visited the place frequently, expecting to see them.

B. Pieridae.

B. 7. 2. **Prioneris sita.** Scarce. A few seen above Vitecolli from October onwards; 3 caught out of a bunch of 10 sitting on wet sand on the Paiaswami river at m. 13 ? on 27-12-32.

B. 9. 2α. **Huphina n. evagete.** Common between Urti and Vitecolli.

B. 9. 3 β. **H. nadina remba.** ♂♂ common from October on, the only 2 ♀♀ seen were taken by me on 20-10-32.

B. 10. 3α. **Appias indra shiva.** Scarce. A few seen near Vitecolli in October only.

B. 10.5 β. **A. lyncida latifasciata.** Very rare. One only seen (and missed) sitting among a host of *A. a. darada* near Maukut. Curiously enough, I took 2 and saw others in my compound at Cannanore in June.

B. 10. 6 β. **Appias albina darada.** First seen on 2nd October, after which it disappeared till it reappeared in myriads at the end of December, all along the river from Urti downwards.

♀ *var. semiflava.* Scarce. Only a few seen and 3 caught on 22-1-33.

B. 10. 7 β. **A. p. wardii.** None seen till January when it appeared with the last named in fair numbers.

B. 17. 1. **Ixias marianne** B. 17. 2 β. **Ixias pyrene frequens** Common from Urti to 2 miles below Vitecolli.

B. 18. **Colotis. fausta.** Seen and taken about 1 mile above Urti in November.

C. etrida and **C. danae** also seen at the same spot.

C. Danaidae.

C. 3. **Euploea c. coreta** Fairly common above Urti.

D. Satyridae.

D. 2. 3α. **Mycalesis a. anaxias.** *Very rare.* Only one seen and caught, on Sampaje ghat at m. 13 on 29-10-32. I never saw any in the 'wate', where Yates records it flying with *Z. saitis;* though I combed out the area from above Vitecolli right down to below Urti. I frequently disturbed *D. l. lepida* but nothing else besides *Z. saitis,* and a very occasional *Parantirrhoea marshalli.*

D. 2. 32 β. **M. p. junonia.** Only taken close round Vitecolli in November, none seen there (or anywhere else), before or after.

D. 3. 24α. **Lethe rohria nilgiriensis.** Fairly common.

D. 3.25 β. **L. drypetis todara.** Very common round Vitecolli, but nowhere else.

D. 16α. **O. medus mandata.** Commonest in the Eastern jungles from November to January; it swarmed in Nagerhole in December. Very few seen on the ghat road.

D. 22. 2 β. **Melanitis phedima varaha.** Not met with till October, when 2 or 3 W.S.F. were taken near Vitecolli; later on, in November, D.S.F. were common at the same spot, and also at m. 13. Sampaje ghat.

D. 22. 3α. **Melanitis z. gokala.** Rare. Saw and took a few on the Sampaje ghat road in December.

E. 10. 3 β. **Discophora l. lepida.** Not uncommon. First seen near Urti at end of October; fresh specimens caught up to 22-1-33.

F. Nymphalidae.

F. 1. 2 β. **Charaxes polyxena imna.** Rare. Only 2 seen, one on Sampaje ghat, sitting on shingle, and one, also sitting on shingle, at Maukut. A difficult insect to catch.

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F. 1. 7 β. **Charaxes f. fabius.** Rare. Only one seen and taken, on human excreta at roadside, below Urti.

F. 2. 1α. **Eriboea sch. wardi.** Very rare. Only one seen (and missed) sitting on cowdung in middle of the road below Urti.

F. 2. 2 β. **Eriboea a. agrarius.** Common from December onwards, mostly from Urti downwards.

F. 6. 8 β. **Apatura p. atacinus.** Rare. One ♀ taken on Sampaje ghat on 27-12-32. No others seen.

F. 18. 26 β. **Euthalia e. laudabilis.** Rare. One only seen on Urti ghat.

F. 25. **Pantoporia ranga karwara.** Rare. A few seen near Vitecolli in November.

F. 26. **Neptis c. nilgirica.** Rare. Only seen on Sampaje ghat.

F. 27. 1α. **Cyrestis th. indica.** Common on the Sampaje ghat, only a few seen on the Urti ghat.

F. 34. 1 β. **Kallima philarchus horsfieldii.** Rare. One or two only seen on the Sampaje ghat in December, and one seen at Maukut in February.

F. 35. **Precis.** All seen, *atlites* the commonest.

F. 36. 1. **Vanessa canace viridis.** Not common. Mostly high up, Vitecolli and above.

F. 42. 1. **Atella phalanta.** Fairly common.

F. 42. 2 β. **Atella a. mercea.** First seen on Sampaje ghat in October, later found all over both ghats, but not high up.

F. 44. β. **Cynthia erota saloma.** Rare. No ♀♀ seen at all. None seen after November.

F. 45. 4 β. **Cirrochroa t. thais.** This only appeared at end of October.

F. 47. 2 β. **Cethosia m. mahratta.** Rare. ♀♀ especially so. Not seen after November.

F. 52. **Telchinia violæ.** Not common.

G. 1. 3 β. **Libythea myrrha carma.** Very local; appeared at beginning of January, near Urti only.

G. 4. 5 β. **Abisara echerius suffusa.** Not common, a ♀ taken at Vitecolli in November.

H. Lycaenidae.

With the exception of:—
Castalius rosimon.
Tarucus t. naira.
Cheritra f. jaffra.

The Lycaenids appeared in October and continued up to February, when I left the area. Those not seen at all are given in Group IV.

I. Hesperiidae.

I. 16. 13α. **C. l. leucocera.** Rare. Only 2 seen and taken.

I. 25. 2. **Col. d. dan.** Not rare. From Urti to Vitecolli.

I. 31. 1. **O. angulata.** Not rare. Appeared early in December.

I. 32. 1. **Caprona r. photiphera.** Not rare. Low down on Urti road.

I. 34. **S. galba.** Scarce. A few seen at Mercara in December.

I. 56. 2. **Baracus v. hampsoni.** Rare. One one seen and taken at Sampaje.

I. 62. 1α. **Suastus gremius.**

I. 74. 3α. **Notocrypta p. alysia.** Rare. Only 2 seen at Vitecolli in November.

I. 74. 5. **Notocrypta curvifascia.** Rare. Only 2 seen at Vitecolli in November.

I. 75. 1β. **Gangara t. thyrsis.** Rare. One seen at Maukut. This species is very common on the coast, large numbers used to arrive on the flowers of the club garden at Cannanore after sunset, in January 1933.

I. 99. 4. **Halpe hyrtacus.** Rare. One taken on 'ramtulasi' at Vitecolli, 2 others seen at same spot, in November.

I. 106. 7. **Padraona d. pseudomoesa.** Scarce. A few seen and taken at end of October near Urti.

I. 106. 8β. **P. p. tropica.** As above.

I. 108. 1. **Telicota a. augias.** Scarce. As above.

I. 108. 2α. **Telicota p. bambusae.** Common and well distributed.

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I. 115. 15β. **Baoris p. philippina.** Rare. 2 caught and seen at end of November at Vitecolli.

I. 115. 18α. **Baoris conjuncta narooa.** Rare. One only seen and caught at Mercara at end of December.

I. 115. 23. **Baoris p. contigua.** Scarce. One only seen and caught at Vitecolli in December.

I. 115. 30β. **Baoris zelleri collaca.** Not uncommon, from November onwards.

Group IV.—Those species not seen at all.

A. Papilionidae.

A. 4. 13. **P. crino.**

B. Pieridae.

B. 8β. **Belenois m. mesentina.**
B. 10. 4α. **Appias l. libythea.**
B. 20 2α. **Pareronia c. ceylonica.**
B. 20. 3. **Pareronia v. hippia.** This species was taken by me at Cannanore, but not in Coorg.

C. Danaidae.

Danais d. nilgiriensis.

D. Satyridae.

D. 2. 11. **Mycalesis igilia.**
D. 2. 14. **Mycalesis subdita.**
D. 2.16 β. **Mycalesis khasia orcha.**
D. 2. 20. **Mycalesis khasia adolphei.**
D. 42. 3α. **Lethe europa ragalva.**

F. Nymphalidae.

F. 10. 1α. **Euripus c. meridionalis.**
F. 19. 10. **Euthalia telchinia.**
F. 18. 14β. **Euthalia g. meridionalis.**
F. 18. 17β. **Euthalia l. arasada.**
F. 18. 27. **Euthalia nais.**
F. 33. β. **Doleschallia b. malabarica.**
F. 36. 1. **Vanessa cardui.**
F. 36. **Vanessa indica pholoe.** I searched the localities at Mercara in December (mentioned by Yates), but saw none.
F. 48. **Byblia illythia.**
G. 1. 2α. **Libythea l. lepitoides.**
G. 4. 5α. **Abisara echerius prunosa.**

H. Lycaenidae.

H. 5. 4. **G. biggsii.**
H. 16. 3β. **Euchrysops p. pandava.**
H. 20. 16. **Lycaenopsis l. lilacea.**
H. 21. α. **Chilades laius.**
H. 22. 1α. **Zizera trochilus putli**
H. 32. 1. **Azanus uranus.**
H. 32. **Azanus jesous.**
H. 4 . 1β. **Iraota t. timoleon.**
H. 47. 1β. **Horsfieldi a. anita.** This species was abundant on the Kodaikanal ghat road in May 1932, but I never saw one in Coorg.
H. 48. α. **Thaduka m. kanara.**
H. 50. No **Amblypodia** seen except *centaurus pirama* and this was scarce, though common at Cannanore.
H. 57. **Apharitis lilacinus.**
H. 58. No **Spindasis** seen at all.
H. 59. **Zesius chrysomallus.**

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H. 61. No **Pratapa** seen.
H. 65. No **Tajuria** seen.
H. 82. No **Horaga** seen.
H. 83. **C.e. myositina.** This was not uncommon on the Kodaikanal ghat in May, but I never saw it in Coorg.
H. 84. No **Chliaria** seen.
H. 88. No **Deudoryx** seen.
H. 89. No **Virachola** seen.
H. 90. No **Rapala** seen in Coorg, but I took *R. schistacea* in Malabar.
H. 92. No **Bindahara** seen.

I. HESPERIIDAE not seen.

I. 16. **Hasora b. badra.**
I. 12. **Hasora alexis.**
I. 13. **Hasora t. taminatus.** Several taken in Malabar but not seen in Coorg.
I. 2. **Ismene.**
I. 3. **Bibasis**
I. 5. **Rhopalocampta benjamini.**
I. 16. 1. **Celaenorrhinus ambareesa.** Taken on the Vaitri but not seen in Coorg.
I. 16. 19. **Celaenorrhinus ruf. area.**
I. 26. **Sarangesa purendra.**
I. 28. **Tapena thw. hampsoni.**
I. 54. β. **Astictopterus j. olivasces.**
I. 57. 1. **Amphittia dioscorides.**
I. 60.1. **Arnetta vindhiana.**
I. 62. 3. **Suastus rama bipuvetus.**
I. 80. **Matapa aria.**
I. 82. 1β. **Hyarotis a. adrastus.**
I. 82. 2. **Hyarotis basiflava.**
I. 83. **Styx (Kineta) microstictum.**
I. 87. **Plastinaga s. kanara.**
I. 99. 8. **Halpe** { **sitala.** **astigmata.** **honorei.** **moorei.**
I. 99. 33α. **Halpe homolea.**
I. 103. **Cupitha purreea.**
I. 104. 1. **Nicevillea concinna.**
I. 104. 2. **Nicevillea gola.**
1. 115. 1. **Baoris oceia farri.** Taken in Malabar only.
1. 115. 5α. **Baoris s. subochracea.**
1. 115. 6γ. **Baoris mathias.**
1. 115. 14. **Baoris kumara.**
1. 115. 28β. **Baoris guttatus bada.**
1. 115. 29. **Baoris canaraica.**
1. 115. 31 β. **Baoris bevani bevani.**

Points of special interest are the extreme rarity of certain species which Yates recorded as quite common.

Such were (1) *Mycalesis a. anaxias;* for which I searched all over Coorg, but only obtained one specimen, on the Sampaje ghat, in October.

(2) *Mycalesis p. junonia.* This species was very common this year (1933) in the Nilgiris, but it was scarce in Coorg in 1932-33.

(3) *Apatura p. atacinus.* This butterfly is common at Kodaikanal, but I only saw and caught 1, a ♀ in Coorg.

(4) *Cynthia erota saloma.* This was quite common on the Manantoddy Ghat road (Malabar), but it was rare in Coorg.

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ON THE BIRDS SEEN OR COLLECTED BY MR. H. ST. J. PHILBY DURING HIS EXPEDITION TO CROSS THE RUB AL KHALI.

BY

N. B. KINNEAR, M.B.O.U.

(Zoological Department, British Museum).

During his journey through the 'Empty Quarter', or the Rub al Khali, Mr. Philby collected a number of birds which were presented to the British Museum by H. M. King 'Abdul 'Aziz ibn Saud of Arabia. They consist of 37 specimens belonging to seventeen species. In addition Mr. Philby kept daily notes of the birds seen which he has included in his book *The Empty Quarter*, and these notes I have extracted which, together with the specimens, form the basis of this paper. Of the birds collected the Arabian Stone-Curlew, Cream-coloured Courser, Houbara (also a winter visitor), Bifasciated Lark, Arabian Black-tailed Lark and Raven are residents; the Desert-Warbler is also probably a resident and perhaps the Aucher's Shrike. The remainder —the Sparrow Hawk, Scops Owl, Hoopoe, Wagtails, Persian Short-toed Lark, Eastern Desert Wheateater, Pied Chat, Persian Stone-Chat are either winter visitors or migrants passing through to their breeding grounds further north.

It is unnecessary to give a description of the journey, since Mr. Philby has given full details in his book, and in a more condensed form in the *Journal of the Royal Geographical Society*, vol. lxxxi, pp. 1-26 as well as in the *Times* newspaper. For those, however, who have not read any of these accounts it will suffice to say that Mr. Philby started from Hufuf in Hasa on 6th January 1932, and went S.-E. to the head of the Gulf of Bahrain, from there S.-W. to the Jabrin oasis, thence more or less due south to about latitude 19°, the furthest point south reached. The expedition then eventually went due west to Sulaiyil which was reached on 15th March.

The monotony of desert travelling was frequently relieved by the presence of desert warblers or bifasciated larks, but the sight of migrants on their way north, especially on the march through the dead world of sand, was specially pleasing and Mr. Philby describes how he was thrilled by the sight of a hoopoe and a passing swallow. Then, after the final effort over the 'waterless waste', as he calls the desert of the last five or six days of the journey, Sulaiyil was reached and:—'the *Sarh* trees in full bloom were a delight after the treeless desert, standing 20 to 30 feet high, as also the acacias, adorned with their charming yellow tassels. Birds sang or twittered in their branches and swallows swooped low along the ground snapping up the insects that hummed gently among the flowers of spring. It was indeed a charming scene!

Mr. Philby unfortunately had very little previous experience in preparing specimens, and it was no wonder that he found the skinning of birds a great tax on the short time available at the end of each day's march. Three or four days after starting he came to the conclusion that he could no longer prepare birds himself since, he writes:—'I had to do everything myself and found in consequence that everything was falling sadly into arrears. Even my journal was not up to date, and I was aware from previous experience that arrears of work accumulated beyond a certain point can never be overtaken. This applied frequently to the collecting of birds and mammals which had either to be skinned when fresh or thrown away before they came too unpleasant. So far we had met with little to shoot except a few birds, but most of these had been thrown away and I regretfully arrived at the conclusion that to make time for other things I must jettison the activities connected with collecting anything that required skinning. Before doing so, however, I decided, as a forlorn hope, to teach Sa'dan the very little I knew about the art of skinning. So we struggled that night with the curlew, the blind leading the blind, and after a day or two of similar joint efforts it

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was he who took on the whole responsibility of preparing the specimens collected during our wanderings!'

With the help of Sa'dan, his servant, Mr. Philby managed to get together the collection of skins, indifferent perhaps as cabinet specimens, but sufficient to show what species inhabit these desolate and arid regions. At Shanna, the furthest point south reached by the expedition and about half way, unfortunately Mr. Philby's gun was put out of order and so no further specimens could be obtained, but he continued to keep careful notes of all the birds he saw. Mr. Philby is to be heartily congratulated on the collections he made, in spite of the many difficulties and discomforts of desert travelling. In addition to the birds he brought back 24 mammals, 81 reptiles and amphibia, over 370 insects, a number of recent and fossil shells, many rock specimens, several pieces of meteorites and a collection of plants, all of which have been presented to the British Museum by H. M. King 'Abdul 'Aziz ibn Saud of Arabia.

Burhinus oedicnemus astutus. Arabian Stone Curlew.
♀ 10 January Jaub Ba'aij; 11 January Jafura.
Native name.—Karwān.

Cheesman met with this Stone Curlew in the Jafura desert and shot one at Salwa, where also Mr. Philby obtained an example on 11 January and another at Jaub al Ba'aij on the 10th. Just south of latitude 20° at 'Ain Sala, in the Rub' at Khali, tracks of a Stone Curlew were noted in the vicinity of the camp and though the bird was never seen it appeared from its tracks to have visited the camp every night during the five days' stay. Mr. Philby remarks that 'its persistence suggested some attraction by the water or moisture of the well area' but since the well at this camp was a 'dead' one there must have been something else which was attracting the bird. Tracks of another were seen further south in the Hibaka tract, but again the bird itself was not seen.

The Arabian Stone Curlew ranges right across Arabia and in addition to Cheesman's examples we have specimens from Mascat and two from the Amiri district of the Yemen. Meinertzhagen collected two near Aden in January. Beyond these limits it is found in Iraq, Southern Persia and Baluchistan.

Chlamydotis undulata macqueenii. Houbara.
1♀ 4 February Hadida.
Native name.—Houbara.

In the appendix to *The Empty Quarter* I omitted to state that the Houbara breeds in Arabia as well as coming there in winter. Mr. Philby found a nest with four eggs on 10 April 1918 near Shauki, between Hafaral Batin and Rujadh and Major Cheesman had three eggs given him, which were taken between Hufuf and Rujadh on 14 February. He also saw tracks in Jabrin in February. Of the Houbara in northern Jafura, Mr. Philby writes 'Tracks of bustard were observed quite frequently, but only once during these early days did we have a distinct glimpse of the bird itself, which has now grown very timid of man's presence and is being rapidly thrust back into the more inaccessible parts of the desert by the new habit of hunting with motor cars. Ibn Jiluwi, like the King himself, decimates them at the rate of 50 or 60 a day in his shooting expeditions, and one wonders how long the bird, presumably a migrant to Arabia, where it breeds, will take to develop an aversion for these parts of the country where cars can overtake their rapid flight'. We, I regret to say, introduced this pernicious sport of hunting both gazelle and bustard by motor car, and during the war in Iraq a general order was issued forbidding the hunting of gazelle by motor car. Mr. Philby tells me that in certain parts of Arabia gazelle have been practically exterminated through continual shooting from cars and the numbers of Houbara are bound to be affected if this form of hunting is continued, unless the birds betake themselves, as Mr. Philby suggests, to parts where they cannot be pursued in a car. But the Houbara is not only hunted with motor cars since the Arabs still take it in the old way by falcons and three so captured were presented to Mr. Philby by a young Shaikh. In Southern Jafura tracks are also seen and at Sanam in Wabar on 4 February fresh tracks were met with and 'Ali following them up with my gun brought back the only specimen of the bird to be secured during all our wanderings.' Near Naifa, well in the middle of the Rub al Khali

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tracks were seen abundantly, also in the Bani Jafnan district and at Unm al Tina near the most southerly point reached by the expedition three were actually seen. These records of actual birds and tracks have been given in full to show that the Houbara ranges right across the Rub al Khali. This bustard breeds in Central Asia, Baluchistan and Persia westwards to South Russia and Syria. In winter it moves south and is not uncommon at that season in north-western India, while, though some breed in Arabia, the majority found there in the cold weather are probably winter visitors. Stragglers not unfrequently occur in Europe and four examples have been recorded from the British Isles.

Cursorius cursor cursor. Cream-coloured Courser.
♂ 19 December Ma'aizila (near Riyadh).
Native name.—Daraja or *Darjalan.*
This was the only specimen collected but Mr. Philby had previously met with this species at Riyadh and remarks that 'in Northern Jafura the Cream-coloured Courser was fairly often seen but by no means as plentiful as I have found it in other parts of the country'. A single example was obtained by Col. Miles at Mascat. Cheesman met with it near Hufuf and it occurs near Aden.
The Cream-coloured Courser breeds in the arid or semi-arid areas from Algeria to N.-W. India and some in winter are found as far south as Somaliland.

Vultures.
Native name.—Nasr.
In Northern Jafura a pair of vultures were seen which Mr. Philby was unable to identify. He writes:—'A diversion was created by the appearance of a pair of vultures (Nasr) at which Ibn Humaiyid had an unsuccessful shot after some elaborate manoeuvring while 'Ali Johman, his close relative, stoutly refused to try his prowess on such creatures. The Oryx-hunter, he said by the way of explanation, does not go after such carrion. But it transpired later that, in the days when he had studied religion seriously, his teacher had discouraged the shooting of the unclean bird'. Major Cheesman saw both the griffon (*G. fulvus*) and the Egyptian vulture (*N. percnopterus*) in Hufuf.

Aquila sp.? Eagle.
Native name.—'Agāb.
Eagles are reported by Mr. Philby on several occasions, but unfortunately no specimens were obtained. A pair were stalked and missed on the Esturary of Jiban, one was seen in Jafura and another unsuccessfully approached above the plain of Shuqqat al Khalfat. After Mr. Philby's gun was out of action one was observed at close quarters near Ziqirt, 15 miles from Naifa and again in the Bani Jafuan, while in the Hibaka Qa 'amiyat district 'afar off ahead of us an eagle was soaring about in stately solitude, stalking food'. Cheesman saw a very dark eagle at Jabrin chasing a hare, Yerbury and Barnes reported the Golden Eagle (*Aquila chrysaëtus*) near Aden, but obtained no example, while the latter author also records *Aquila imperialis* from the same locality, but again was unable to confirm his observation by a skin. The only species actually recorded from S.-W. Arabia is the Abyssinian Tawny Eagle (*Aquila rapax raptor*), which Meinertzhagen obtained near Aden on 13 April 1923.

Accipiter nisus nisus. Sparrow Hawk.
♀ 12 January Anbak.
Native name.—Shabbut.
At Anbak on 12 January Mr. Philby writes 'Tamarisks also struggled with reeds and palms for existence, and a pair of Sparrow Hawks ("Shabbut") seemed to have good hunting amongst the numerous warblers and small creatures until one of them was stalked by Salih and shot at such close range with my gun that its head was almost completely blown off'. Further north at Hufuf Cheesman also met with a pair in November and on 10 April 1921 he saw one at Bahrain. To the southwards there are other records of the Sparrow Hawk—a male was obtained by Col. Yerbury at Lahej on 8 March and he reported the species to be not uncommon in the Aden district, where also Col. Meinertzhagen shot a female on 24 January.

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This form of the Sparrow Hawk breeds in Europe and Western Asia and some migrate as far south as the Sudan and Abyssinia.

Otus scops scops. Scops Owl.
1-13 March Hidbat al Farsha.
Native name.—Qubaisa.
After crossing the waterless desert and the gravel plain the expedition passed into a country still covered with gravel, but intersected with numerous channels along which grew a dark green plant the 'Harmal' of the Arabs (*Rhazya stricta* Dcne.) and Acacia bushes. Here a Scops owl was found by Salih in the deserted burrow of a spiny-tailed lizard ('Dhabb').
At Shanna on February 22 Mr. Philby heard a small owl, which he took to be this species, but was unable to locate it.
The Scops Owl is a migrant in Arabia and we have in the British Museum an undated example collected by Col. Miles at Muscat, another obtained by Barnes near Aden on 28 September and a female shot by Bury on 21 March in the Amiri district. These are all the records for S.-E. and S.-W. Arabia I know of for this little owl, which breeds in Europe eastwards to Asia Minor and Palestine and migrates south in winter as far as Uganda. It is a rare wanderer to the British Isles.

Upupa epops epops. Hoopoe.
Native name.—Hüdhud.
About the middle of the Sanam, on 4 February, a hoopoe was seen, which Mr. Philby says gave him as great a thrill as the swallow in the Numaila sands, he adds 'Salih went in pursuit and after an elaborate stalk fired at it, but the only result was to hasten its passage.'
According to Cheesman the Hoopoe does not winter in Hasa, but he noted it on passage during March. In the Aden district however, it appears to be a cold weather visitor and there are specimens or records of it in January, February, March, July, August and September.

Motacilla alba subsp.? White Wagtail.
1?-15 March Sulaiyil.
Native name.—Aqaili or *mislik.*
This single example is not in sufficiently good condition to identify the race, but probably it is the Indian White Wagtail *M. alba dukhunensis*, recorded by Cheesman as a common winter visitor to the Hasa oasis. He also noted it at 'Uqair on 6 March, on the 29th at Salwa and again on 5 April all of which he considers were probably migrants on their way north. Meinertzhagen also observed small parties of this same race moving north at Aden early in February, the movement continuing till about 25 April.
Mr. Philby records seeing wagtails in the desert on two occasions, which may have belonged to this race. The first was on the second day out from Naifa, at the close of a march of 27 miles through a particularly lifeless region, described by Mr. Philby as 'very depressing and only relieved by the presence of a wagtail and a desert warbler'. The second occurrence was a few days later during the crossing of Shanna when 'a wagtail greeted us with its unfamiliar chirrup and fled from us with graceful dives, but it was the only sign of life in that waste scene.'

Motacilla feldegg feldegg. Black-headed Yellow Wagtail.
? 14 March, 2 [♂] 15 March 1932 Sulaiyil.
Native name.—Sa'u ♂ Sa'wa ♀.
These three examples were obtained at Sulaiyil after completing the desert journey. According to Yerbury and Barnes, this species is occasionally met with in the Aden Protectorate and we have in the Museum a female from thence, shot by Chevallier in May 1885, as well as a male obtained by Messrs. Percival and Dodson on 20 September 1899. Major Cheesman saw this wagtail on migration at 'Uqair in March.

Suliva nana nana. Desert Warbler.
2♀ 6 February Sanam; 1-7 February Majari; 1-8 February Bani Jallab; 11 February 'Ain Sala ♂ 12 February Adraj.
Native name.—Suwaiwala.
Cheesman found the Desert Warbler common in Jabrin and Mr. Philby obtained specimens as far south as 'Ain Sala, latitude 19°57′ N., right in the

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middle of the Rub 'al Khali, some seventy miles north of his most southerly point. He remarks that 'it was interesting to see how these little warblers fly from bush to bush almost invisibly in long graceful swoops close along the ground—to avoid the keen eye of hawk or raven.' While crossing the waterless waste, after leaving Naifa, he records on 6 March that 'the only living thing we saw before our morning halt about 11 a.m. was a single Desert Warbler.' During the rest of the march the country became more and more bare with only scattered *abal* bushes and very little (though still something) of other plants.' The absence of any life became very depressing and by the end of the day's march—twenty miles—only four birds had been seen, another desert warbler, a wagtail and a single raven. On the next day the desert was more lifeless than ever and all the plants were dry and dead, the only sign of life being a swallow passing on migration, a butterfly and a desert warbler while on the following day in similar drought-stricken country another desert warbler was disturbed in passing.

This little warbler breeds in the desert parts of Eastern Persia and further north in the Caspian region. It may perhaps breed in Arabia and Palestine but there is no definite information. In winter it is found in Egypt, Palestine, Arabia and N.-W. India.

Lanius excubitor aucheri. Aucher's Shrike.

♀ 21 November 1931 Qai 'iya 3,500.

This single example was collected in Najd before commencement of the journey proper. Mr. Philby saw a shrike at Shanna, the only one seen during the crossing, which he thought was the same. This shrike is often confused with *L. e. pallidirostris*, but we have examples in the Museum from South Jabrin (Cheesman), Muscat (Cox and Mills) and Aden and vicinity (various collectors).

It breeds in Persia, Iraq, parts of Northern Arabia and Palestine migrating in winter as far south as Somaliland.

Alaemon alaudipes doriae. Bifasciated Lark.

1 ♂ 2 ♀, 25 January, Maqaimama; ♀ 27 January, Hawuja, ♂, 1?, 31 January Tuwairifa; 1?, 1 February, Sa'afij; ♀ 6 February Sanam.

Native name.—Umm Sālim.

The Bifasciated Lark was met with at many places throughout the journey and, along with the Raven and the Desert Warbler, was the most frequently seen bird. It is found in the interior of the Rub al Khali as also are these two species.

Apparently these larks were more often heard than seen and Mr. Philby mentions time after time that he heard the piping note but could not make out the bird. This is not to be wondered at since this lark must be very difficult to see, on account of its sandy colour, as long as it keeps still. On the march to Faraja, Mr. Philby writes 'The only sign of life on the whole march had been a single Bifasciated Lark, whose piping announced its presence long before I could detect it tripping along the ground out of our way. In all these bare districts the desert birds seldom seem to take to their wings, generally preferring to run along the ground which provides them with almost perfect protection from birds of prey. A flying bird is often betrayed by its dark shadow on the ground! On 6 March Mr. Philby again writes 'a pair of larks piped at each other in the cool, still air of the morning, the notes of the sexes being as I thought, very different.' Later while crossing the gravel plain the only living thing actually seen in that desolate waste was one of these larks.

Calandrula rufescens persica. Persian Short-toed Lark.

♀ 23 January 1932 Summan camp near 'Uj 22°40′ N.; 1? 29 January 1932 Numaila 22°56′ N.

Native name.—Hamrā.

This Short-toed Lark, which breeds in Persia, was obtained by Cheesman at Umm-al Salar, Hufuf in January and December. In Mr. Philby's book I recorded this lark as *C. bracdyctta hermonensis*, but the specimens have since been cleaned and turn out to be the above species.

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Ammomanes cinctura pallida. Arabian Black-tailed Sand Lark.
♀ (?) 22 November 1931 Khufaifiya, Najd; ♀ 14 January 1932 Jafura.
Native name.—Hamrā.

Previous to Major Cheesman's discovery of this small desert lark in Hasa it was only known from the type, which came from Qunfida in the 'Asir Province on the Red sea littoral. Then in 1930 Mr. Thomas collected a specimen in Dhufar and now Mr. Philby, besides obtaining an example in Jafura, also procured one at Khufaifiya west of Riyadh. This bird is probably widely distributed over Arabia and two birds collected at the south end of the Red Sea in 1909 by Mr. Douglas Carruthers, appear to belong to this race. The two specimens listed, I at first thought were darker than Hasa examples, but this was due to the feathers being soiled with grease.

Oenanthe deserti atrogularis. Eastern Desert Wheateater.
♂ 24 January Maquainama; 2 ♂ 31 January Tuwairifa; ♂ 2 February Sa'afij.
Native name.—Umm Ghurair.

This Desert Wheatear nests in Central Asia and passes south in winter to North Africa and India, many wintering in Arabia. Stragglers have occurred in the British Isles, in Kent and the Orkney Islands.

Bertram Thomas obtained one at A'ain water-hole on the edge of the Rub al Khali in January and a second at Sa'atan in Dhufar on 30 February. According to Cheesman this is the most plentiful wheatear in Jabrin during the winter and he obtained specimens in November and February, while Meinertzhagen found it common at Aden, where Kalsal also collected a male in February and near Lahej Percival and Dodson met with it in September.

Oenanthe leucomela. Pied Chat.
♂, [♀] 15 March 1932 Sulaiyil.
Native name.—Bijri or *Da'ja.*

This specimen was brought to Mr. Philby at Sulaiyil after the desert journey had been completed. Major Cheesman records Pied Chats on migration at Jabrin, Bahrain and Salwa in February, March and April and there are other records of it during the spring and autumn migration from Mascat, the Yemen and the Aden district, where a certain number of birds appear to pass the winter.

Saxicola torquata maura. Persian Stonechat.
15 March Sulaiyil.
Native name.—Busaiya.

This is the second record for the Persian race of the stonechat in Arabia, Bury having previously obtained one at Majeilah, Yemen in April 1913. The summer quarters are in the Urals and Caucasus.

Corvus corax ruficollis. Brown-necked Raven.
Native name.—Ghurāb.
♂ 21 January Jabrin; ♂, ♀ 25 January Numailu; , 8 February Hadh Fāris.

As already mentioned under the Bifasciated Lark, the Raven was one of the three commonest birds seen during the journey, but even in the desert it was a difficult bird to approach. In Northern Jabrin Mr. Philby records that 'whenever the camels were turned out to graze a pair of ravens circled round them, perching now and then on their backs in search of ticks.' He attempted to secure one as a specimen 'Ali piloting me by a devious route, but the birds of this desert are mistrustful of human beings and I had to be content in the end with a distant, unsuccessful shot, after which we saw our visitors no more.' Two pairs were seen near Hadh Fāris, one in the vicinity of a new nest in which however no eggs had been laid in yet. Old nests were seen at numerous places and on January 28 three unfledged young were found at Madara. At 'Ain Sala 'a pair of ravens circled round to witness our arrival and remained in attendance, though at a discreet distance, during our sojourn of five days from February 10th to 15th'. At times however they almost forgot their fear of man and 'occasionally they even ventured into our camp during its somnolent moments.'

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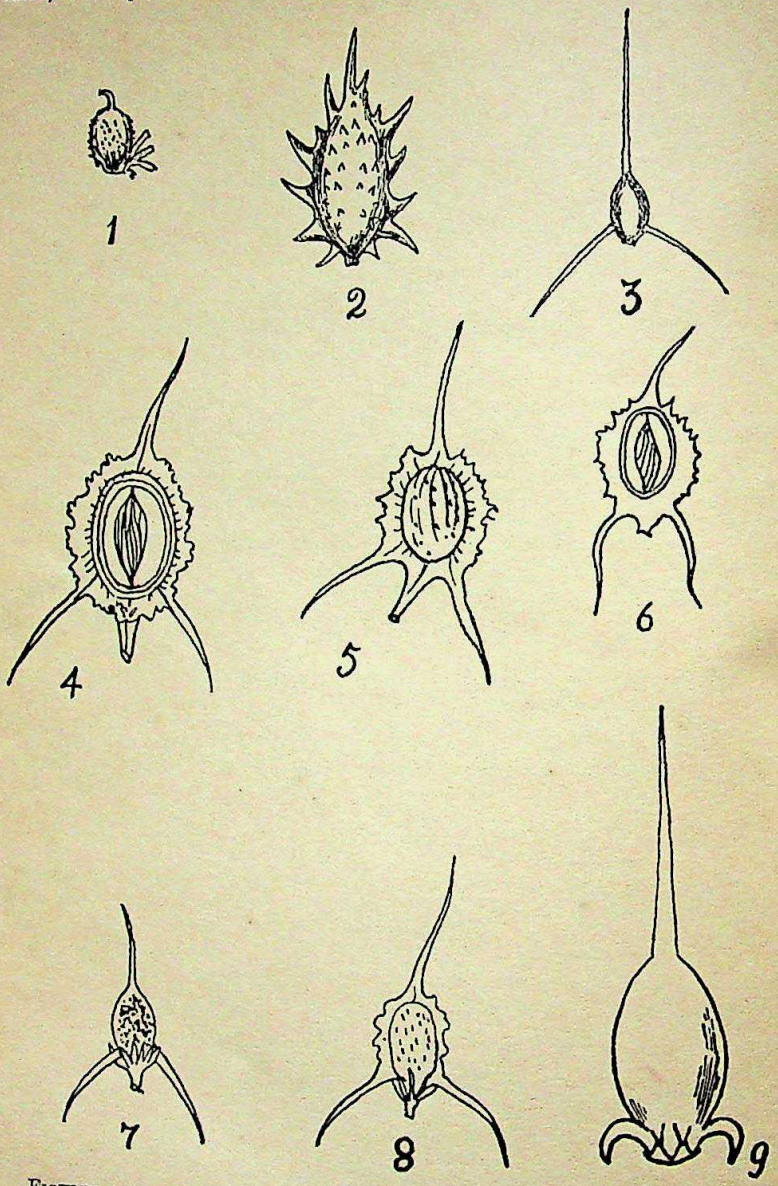

FIGURES COPIED FROM VARIOUS WORKS ATTRIBUTED TO *C. demersum* L.

1. *A Students' Ill. Irish Fl.* (1931), p. 19, fig. 7.
2. *Families of Flowering Plants, I. Dicotyledons* (1926), p. 95, fig. 17-c.
3. *Deutsche Fl.* (Karstens) (1880-1883), p. 581, fig. 346, 6.
4. *Icones Plantarum Indiae Orientalis*, vol. vi (1853), t. 1948, i, 11 (*C. muricatum* Cham.).
5. *Ibid.*, t. 1948, i, 9 (*C. muricatum* Cham.).
6. *Ibid.*, t. 1948, ii, 6 (*C. muricatum* Cham.).
7. *Ibid.*, t. 1948, iii, 3 (*C. tuberculatum* Cham.).
8. *Ibid.*, t. 1948, vi, 4 (*C. missionis* Wall.).
9. *Flora de Catalunya*, vol. ii, p. 352.

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OBSERVATIONS ON *CERATOPHYLLUM DEMERSUM* LINN.

BY

CHARLES MCCANN, F.L.S.

(*With 2 plates and 2 text-figures*).

INTRODUCTION.

The Indian species of *Ceratophyllum* have presented many difficulties to the systematist, especially when in the shape of herbarium material which is frequently without flowers or fruit. The same is true of the genus *Ceratophyllum* in general. Hooker (11), after examining all the material at his disposal, writes: 'I have failed in establishing species amongst the dried specimens of the Indian forms of *Ceratophyllum*, but there are differences in those figured by Wight, that require to be verified by living specimens, and especially the single and bifid segments of the perianth, and the truncate and bicuspidate connective of the anthers, I find great variety in the fruit upon which species have generally been founded, but in no Indian specimens have I seen the short lateral spines which are characteristic of the European species or variety *submersum*'. Hooker considers all the Indian material as one species, namely, *C. demersum* L. and treats the species illustrated in Wight's Icones (27) as mere forms. That there is but a single species, is probably correct; I think, however, that Wight's figures do not represent forms, but certain phases in the maturation of the fruit, as I shall endeavour to explain. Cooke (5) follows Hooker in dealing with the Bombay material.

Hooker's difficulty with regard to the perianth segments and anthers can be explained. Owing to their delicate nature these characters tend to disappear in dried material, and are easily overlooked in fresh specimens. The difficulty arising from the absence of the lateral spines may be explained by the fact that Hooker had to do with either immature or damaged specimens, more likely the former. Ascherson and Graebner (2) have attempted to split the species *C. demersum* into several groups based chiefly on the characters of the fruit. My observations, however, cannot support such a division, and I totally agree with Muschler (22) that 'several species and varieties have been proposed, based on the spurs, spines, or wings of the fruit, but none of them seem to be of any value'. According to the Treasury of Botany (19) 'it varies much in the shape and excrescences of the fruit, and has been accordingly divided by some botanists into six or more supposed species, more generally considered varieties'. There has been much confusion regarding the true characters of the fruit of *C. demersum*, as will be readily seen from plate I. We have here several distinct types of fruit which are all said to be *C. demersum*.

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But surely, there cannot be such marked variations in the fruit of a single species?

Observation and examination of living specimens of *C. demersum* under natural and artifical conditions for a period of over a year have shown many interesting details and given satisfactory explanations for the 'errors' which have arisen with regard to the flowering and fruiting. At first I experienced extreme difficulty in determining the Bombay species owing to the meagreness of the descriptions and the discrepancies in the drawings of the fruit. My observations have led me to conclude that, (i) there is no wide variation in the form of the fruit; (ii) many important details are lost in herbarium material; and, (iii) several significant points have been overlooked by previous workers. In order to facilitate the explanation of the various items of interest I shall refer to them under their respective heads.

In conclusion I wish to express my thanks to Rev. Fr. J. F. Caius, S.J., St. Xavier's College, Bombay, for many valuable suggestions and for consulting much literature in the College Library, and to Mr. C. E. C. Fischer of Kew for copies of certain literature.

Synonymy.

Ceratophyllum demersum Linn. Sp. Pl. (1753), p. 992; Gaertn. Fruct. t. 44; Lindley Treas. Bot. (1876), p. 254; LeMaout & Decaine, Syst. Bot. (1876), p. 735; Boiss, Fl. Orient., v, 4 (1879), p. 1202; Karstens, Deut. Fl. (1880-1883), p. 581, f. 346, 6; Hook. f., Fl. Brit. Ind., v. 5 (1888), p. 639; O. Ktze., Rev. Gen. Pl., pars. ii, p. 644; Krause, Sturms Fl. v. Deut., v. 5, p. 215, f. 48; Cooke, Fl. Bom. Pres. (1907), v. 2, p. 663; Muschler, Man. Fl. Egyp., v. 1 (1912), p. 363; Merrill, Fl. Man. (1912), p. 202; Haines, Fl. Bih. & Or. (1922), p. 841; Aschn. & Graebs., Syn. d. Mitteleurop. Fl., v. 5 (1923), p. 538; Fischer, Fl. Madr. Pres., p. 1391; Herter, Fl. Uruguay (1930), v. 4, p. 61.

apiculatum Cham. in Linnaea, iv (1829), 504.

aquaticum H. C. Wats, Topogr. Bot., i, 165.

asperum Lam., Fl. Fr., ii, 196.

cornutum Reich. in Ann. Mus. Par., v, xvi (1810), 299.

cristatum Spruce ex K. Schum. in Mart. Fl. Bras., iii, 3 (1894), p. 748.

gibbum Laforet, ex Nym. Consp., 251.

missionis Wall. Cat. (1828), n. 7007; Wight & Arn., Prodr., p. 310; Wight Icon. (1853), t. 1948, f. 4.

muricatum Cham. in Linnaea (1829), v. 4, p. 405, t. 5, fig. 6-c; Wight & Arn., Prodr., p. 309; Wight Icon. (1853), t. 1948, fs. 1 and 2.

tricorne Dum., Fl. Belg., 165.

tricuspidatum Dum., Fl. Belg., 165.

tuberculatum Cham. in Linnaea, v. 4 (1829), p. 504, t. 5, f. 6-d; Wight & Arn., Prodr., p. 309; Wight Icon., t. 1948, f. 3.

unicorne Dum., Fl. Belg., 165.

verticillatum Roxb. Hort. Beng. (1814), 68; Fl. Ind., v. 3 (1832), p. 624; Trimem, Fl. Ceyl. v. 4 (1898), p. 120.

Description.

A much branched, rootless, submerged plant with stems exceeding 2 m. in length, when favourably situated. It frequently grows in pure masses.

Leaves: The leaves are arranged in whorls of 8, 5-20 cm. apart; furtherest apart on the oldest stems and branches; 1-3 times dichotomously cleft into filamentous lobes; up to 15 mm. long; stiff and brittle, minutely toothed at irregular intervals, each tooth

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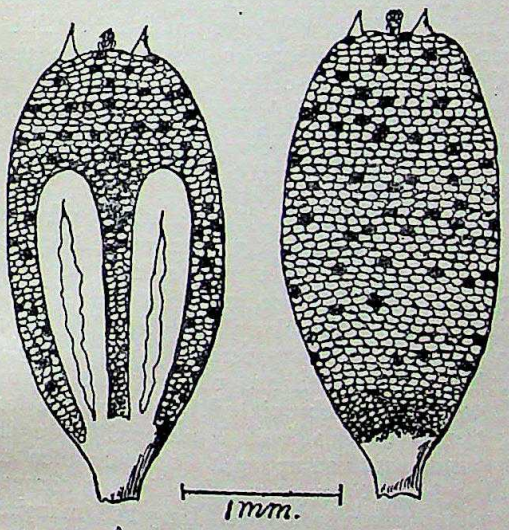
surmounted by a sharp transparent bristle, single and groups of hairs are irregularly scattered throughout. The extremity of each segment is surmounted by two sharp bristles. The colour (a character used by some authors) is variable, pale yellowish green to dark green according to the age of the plants and the situation they are growing in. The tassels of the young leaves are usually paler, and frequently streaked with a reddish tinge. Dark green is apparent when the plant grows old or when it develops in dense shade (Pl. II, fig. 2).

Male flowers: Solitary, in separate axils to the female flowers and usually placed above them. When the plants are growing in dense masses the male flowers are irregularly placed above or below the female flowers and are only developed on the topmost branches which are near the surface of the water and exposed to the maximum of light. Involucre (Pl. II, fig. 7) composed of 6-12, narrow lanceolate 2-fid segments with a transparent glandular appendage in the sinus of the tips, somewhat longer than the depth of the sinus. The bifid nature of the segments is frequently difficult to discern as the tips stick together and are also apparently glandular. Below the tips are usually a few transparent bristles. The tips are usually lost in the herbarium (Pl. II, fig. 5).

Anthers: 1·8-2·5 mm. long, ellipsoid, narrowed into the base, subsessile; apex divided into two spinous incurved processes with a short, transparent glandular process between (turning brown with age). The shape of the anthers is not always constant due to their respective positions and pressure. Anthers 8-30 in each



Text-fig. 1.—Anthers of *C. demersum* L.

flower, pinkish. Anther lobes 2, imbedded in spongy air-containing tissue composed of 'float' cells. Some of the cells are filled with a deep purple colouring matter giving the anthers the pink tinge when viewed by the naked eye. The lobes dehisce by longi-

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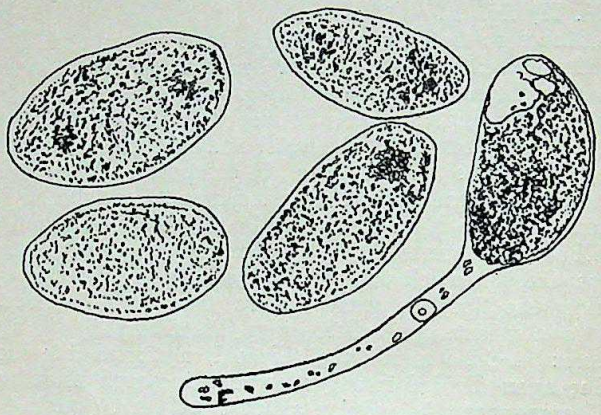
tudinal slits which are only seen on one side of the anthers, the reverse is composed of a mass of 'float' cells. The anthers always float with the lobes in contact with the surface of the water (Pl. II, fig. 6 and text-figures 1, A, B).

Pollen: Copious, colourless, ellipsoid or reniform, with motile circulating protoplasm within, giving the grains a rotary movement. The pollen tubes are sometimes developed before dehiscence of the anther lobes.



Text-fig. 2.—Pollen grains of *C. demersum* L.

Female flowers: Perianth as in the male flowers. Segments also as in the male. (Cooke (5) says not 2-fid). The tips and the glandular appendage often adhere so closely as to give a non-bifid appearance. Ovary sessile, 1-celled. Style curved as in Pl. II, fig. 3, but commences to straighten after fertilisation. The style elongates in fruit and is surrounded by a continuation of the seed coat throughout its length and eventually forming the apical spine.

Fruit: The fruit (Pl. II, fig. 4) is a small subsessile, ovoid or ellipsoid, somewhat dorso-ventrally compressed nutlet (excluding the spines). At the apex is a strong spine (already referred to) and on either side near the base are 2 lateral spines (I have obtained a specimen with 3 basal spines) tapering to a fine point, 6-7 mm. long. These spines generally grow straight (especially in plants which are not in dense masses) but occasionally may be curved, or somewhat abbreviated, possibly due to obstruction when growing densely. The fruit is covered by a thin, smooth, membranous, translucent outer coat (no tubercles or wings are present). Seed 3-4 mm. long, ovoid, slightly compressed, hard, brown, slightly longitudinally rugose along the margins or smooth. The spines are formed as a continuation of the woody seedcoat and frequently persist, but are generally broken off.

Habitat: *C. demersum* is a submerged herb of still freshwaters. It is exceedingly common throughout the islands of Bombay and Salsette, frequently associated with other aquatic vegetation, mostly *Utricularia stellaris*, but generally in almost

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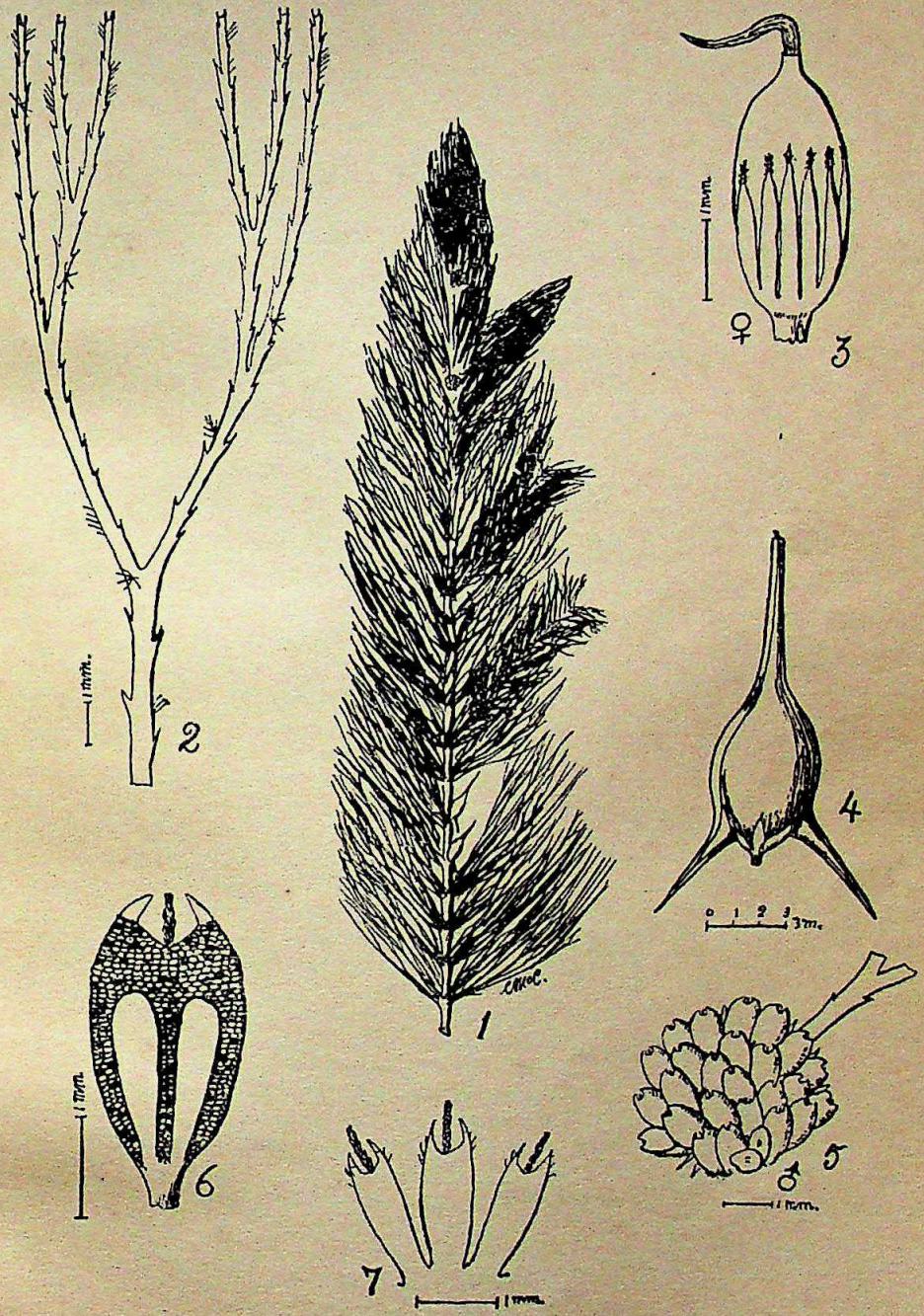

Ceratophyllum demersum L.

1. A branch with fruit and ♂ flowers in position. 2. Leaf. 3. Young fruit. 4. Fruit. 5. ♂ flower. 6. Anther. 7. Segments of ♂ involucre.

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pure societies under the shade of overhanging trees where some of the other aquatic plants cannot thrive. It may occur in deep or shallow water. In situations which dry up during the hot weather bulky masses may be found on the banks coloured greyish white owing to a large deposit of lime within the tissues. As one walks on them there is a crepitating sound like the snapping of dry sticks; and if fragments be held they feel like a heap of brittle glass fibres.

Distribution: Throughout the temperate and warmer zones of the world: Europe, Asia, North and South America, Africa and Australia.

Flowering and Fruiting: Under natural conditions, the flowering and fruiting occur in August-November; but the specimens in my aquarium also flowered and fruited in April-May and continued doing so till the beginning of the rains.

Development of the Fruit.

The young fruit is at first ellipsoid, like the ovary, without any indication of lateral spines. The style begins to straighten after fertilisation, forming the apical spine, together with the cylindric elongation of the outer coat of the fruit which gradually creeps up all round like a sheath. As growth proceeds two lateral tubercles appear on either side of the base of the fruit which finally develop into the two strong, but brittle, lateral spines. As already indicated the fruit is covered by a thin outer coat. It is this coat (pericarp) which has led to so much confusion in the diagnosis of this species. At maturity this outer coat begins to disintegrate and break up very irregularly and in different ways:—

(*a*) it may contract to form small tubercles or wrinkles giving the fruit a tuberculate or rugose appearance:

(*b*) it may split in different ways and flap over giving the fruit a 'winged' appearance as figured by Wight:

(*c*) it may split down longitudinally to one side without disintegrating; the seed escaping from the slit.

This may all happen while the fruit is still attached to the plant or after it has fallen off. At first I was inclined to believe that the wings were algae adhering to the surface of the fruit; but a careful examination soon dispelled this idea.

Considering the different modes the seed coat comes away from the seed it is not difficult to account for the discrepancies in the different drawing reproduced on Pl. I. Fig. 1 is evidently the fruit of *C. submersum* L.; fig. 2 I cannot account for; figs. 3, 7, 9 are an approach to my own drawing; figs. 4-6 undoubtedly represent fruit in which the outer coat has begun to disintegrate. Hence a division of the species on a point of 'winged fruit' falls, as also a separation based on the presence or absence of spines, which is accounted for by the age of the fruit.

The fruit when ripe generally detaches itself from the plant and being heavier than water sinks to the bottom.

Fertilisation.

Fertilisation in *C. demersum* affords curious and interesting details. The male and female flower are borne on the same

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branches, the males are generally protruded above the females. Neither male nor female flowers are ever produced above the surface of the water. The question naturally arises, How is fertilisation affected? Delpino (21) recognised that *Ceratophyllum* was one of the plants adapted for fertilisation under water, adding that 'these require for cross-fertilisation that the stigma or the pollen-grains, or both should be thin and filiform, and the pollen should be abundant and of like specific gravity to the water'.

The large anthers are copiously provided with 'float' cells as already indicated. They may either dehisce below the surface of the water while still on the plant, or break away from the flower in which latter case they float on the surface and then dehisce. In the latter position the anthers drift about discharging their pollen as they go. The pollen contains circulating protoplasm which gives the pollen a rotary motion. This movement is not continuous but interrupted, and gives the pollen the power of mobility. As it sinks in water, the pollen falls on stigmas situated below the male flowers, this naturally results in self-pollinisation in so much as the pollen is from the same individual as the style. However, Nature has provided for more than self-pollinisaiton. The anthers which float on the surface do so in a particular manner, with the sutures downwards. As they are blown about by winds and conveyed by water currents they shed their pollen which reaches 'foreign' stigmas, thus effecting cross-fertilisation. The subulate styles are bent over in such a way (Pl. II, fig. 3) as to offer the greatest possible surface to a 'rain' of pollen. Here we have an extraordinary adaptation of floral parts of submerged aquatic plants to ensure fertilisation.

Summary.

So far as is known but a single species of *Ceratophyllum* occurs within Indian limits. The confusion which has arisen with regard to the status of the Indian species is explained by the fact that species and varieties have been based on phases of the fruit before and at the time of maturation. Another factor which has contributed largely to this misunderstanding is a reference to herbarium material which is generally imperfectly preserved. A reference to specimens preserved in formalin is always necessary when describing species of *Ceratophyllum* as the delicate portions are lost.

The fruit exhibits a series of developmental stages which have led to much confusion in the determination of the species.

Fertilisation is effected by extraordinary adaptations of the plant to pollinisation under water, particularly by floating anthers and motile pollen grains which are of the same specific gravity as water or nearly so.

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BIRDS OBSERVED AT FORT MUNRO, SULAIMAN HILLS.

BY

H. W. WAITE, M.B.O.U.

(*Indian Police*).

With Notes by HUGH WHISTLER.

Fort Munro is situated on the main Sulaiman range at an altitude of 6,300 feet, and is about 50 miles from the Indus, which here runs North and South parallel to the Range. It lies within the Punjab District of Dera Ghazi Khan and is part of the 'political area', a strip of hill territory marching with the Loralai Agency of Baluchistan and administered separately from the District proper.

The Sulaiman hills in this neighbourhood may roughly be described as sandstone with occasional outcrops of limestone. The station is a very small one, there being only about half a dozen residential bungalows, and nothing in the nature of a *bazaar*. Immediately to the west, and some 500 ft. lower, is Khar, a small, cultivated valley with a fruit and vegetable garden watered by a spring. To the East, about 300 ft. below, are two tanks known as Dames' and Trimmu, the former of which provides water for a small garden, while the latter boasts a spring from which the station obtains its drinking supply. At these tanks, and other smaller ones on the hillside, a few poplar and mulberry trees have been planted, and at Fort Munro itself partial success has attended efforts to grow the Blue Pine, Deodar, and Juniper. Otherwise the neighbourhood is bare of trees, save for an occasional stunted olive, and large areas are devoid even of bushes. Clumps of Dwarf-Palm (*Nannorhops ritchieana*) are fairly common, and here and there one comes across patches of a red-berried shrub which the Baluchis call 'pipal' and a species of *Grewia* known locally as 'kirkok'. The Oleander is found in the numerous dry water-courses, and after good rain there is everywhere an abundance of grass. The rainfall in summer is much greater than in the plains below, but even so only averages 10 ins. The winter rainfall is inconsiderable; snow falls in small quantity in some years. The night temperature in June averages 70° or under and indoors during the day is seldom much above 80°. The cold in winter is severe and aggravated by strong winds.

This portion of the Sulaiman Hills was toured in the seventies by Professor V. Ball of the Geological Survey, whose notes on birds which he observed there are to be found in *Stray Feathers* (vol. iii, p. 204). The locality is also mentioned occasionally in Ticehurst's *Birds of British Baluchistan* (*J.B.N.H.S.*, vols. xxxi and xxxii).

The following notes are based on observations made for a few days at the end of September 1930, a day at the end of the same

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month in the following year, and throughout June and July in 1932.

The nomenclature is that of the *Fauna of British India, Birds*, Revised Edition.

I have to thank Mr. Hugh Whistler for much help and interest in my observations and for the identification of all specimens obtained. Notes which he has kindly made are appended within brackets.

1. **Corvus corax laurencei** Hume.

Common and shares the scavenging of the place with *Neophron* and *Milvus*. When, as was usually the case, a high wind was blowing these birds would noisily chase each other and give a wonderful exhibition of aërial gymnastics.

[A pair in moult sent clearly belong to this form.]

2. **Argya caudata caudata** (Dum.)

Resident in small numbers. A nest found in a *Grewia* bush on 4th July contained two hard-set eggs.

[Two males, wings 83 and 85 mm., are very close indeed to *A. c. eclipes* in colour and go better with that form than with the typical race.]

3. **Molpastes leucogenys leucotis** (Gould).

Present in small numbers in the gardens and their immediate neighbourhood. A nest found in a Pine tree on 4th June contained three slightly incubated eggs.

4. **Oenanthe picata** (Blyth).

Abundant in June, when numbers of young birds were still being fed by their parents, largely on *Grewia* berries and those of the *'pipal'* shrub. Practically all specimens obtained, both adult and juvenile, were infested with ticks about the head and neck. A nest still occupied was found on 7th June. This was situated on a beam in the verandah roof of an empty bungalow and consisted of a shallow pad of grass on a substantial foundation of stone chips. The chips averaged about the size of a rupee and had evidently been carried up by the birds. There were three callow young in the nest, one of them dead but showing no signs of decomposition. Several old nests were discovered in holes in walls, rocks, and boulders, and in every case a similar foundation of stone chips had been provided.

By the middle of July there was a marked decline in the number of these birds, which had presumably started moving down to the plains. Odd birds were met with at the end of September. *Œnanthe capistrata* was not seen on any of my visits.

[Ticehurst informs us that the first birds reach Sind in July (*J.B.N.H.S.*, xxxi, 707) and I met the first male in Jhang District in 1919 on 2nd August, so it is evident that the decline in numbers noted at Fort Munro by the middle of July really represented the starting of the Autumn migration.]

5. **Oenanthe opisitholeuca** (Strickl.).

Adults and young birds were fairly frequently met with in June on the same ground as *picata*, but their number was markedly less. They disappeared at the beginning of July, and I did not observe any after the 4th of that month. Doubtless some of the old nests seen belonged to this species.

[My earliest dates for the Punjab are August 15, 1915, at Gujranwala, August 16, 1918, at Lalian, Jhang District, and August 15, 1919, at Jhang-Maghiana].

6. **Saxicoloides fulicata cambaiensis** (Lath.).

Apparently rare at Fort Munro. Only observed on two occasions, on 7th June (two males) and 4th July (one male). No specimen secured.

7. **Monticola solitaria longirostris** (Blyth).

Single birds were met with on four occasions at the end of June. All were juveniles. Not noted in September.

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[These juveniles, all apparently males, have the wings respectively 121, 123·5, 125 and 125·5. They clearly differ from juveniles of *M. s. pandoo* in being much paler, both above and below, and in having heavier beaks.]

8. **Muscicapa striata neumanni** Poche.

Common on passage in September.

9. **Siphia parva parva** (Bechst.).

A few were met with on passage in September.

10. **Tchitrea paradisi leucogaster** (Swains.).

A male in chestnut plumage was obtained in the garden at Khar on 24th September 1931. This was the only one seen.

11. **Lanius vittatus** Valenc.

Common in June and July. Young birds were about in the middle of June. A nest found on 13th June in a Deodar in the compound of an unoccupied bungalow contained three slightly incubated eggs. Another nest in an olive tree by the road-side held two fresh eggs on 26th June.

12. **Lanius cristatus phoenicuroides** Severtz.

A juvenile was obtained on 23rd September, 1931. No others seen.

[A migrant on its way to Africa by the Arabian route. It passes through Sind in small numbers from mid-September to mid-October (Ibis 1922, p. 609).]

13. **Agrobates galactotes familiaris** (Ménét.).

The only one seen was obtained on 1st August, 1932.

[Also a migrant to Africa by the Arabian route. Ticehurst found in Sind that its passage lasted for but a short time, 3rd to 24th September. The earliest date for the Quetta Valley is 30th July.]

14. **Acrocephalus dumetorum** Blyth.

One was obtained at Khar on 1st August, 1932.

15. **Hippolais rama rama** (Sykes).

Sparingly met with on passage towards the end of July.

16. **Sylvia hortensis jerdoni** Blyth.

Observed on three occasions, on 26th June (a juvenile), 14th July, and 22nd July.

17. **Sylvia althaea** Hume.

The only one seen was obtained on 21st July.

18. **Sylvia curruca affinis** Blyth.

One was obtained on passage on 25th September, 1930.

19. **Acanthopneuste nitidus nitidus** Blyth.

One was obtained in the garden at Khar on 28th July, 1932. Common on passage in September.

20. **Scotocerca inquieta striata** (Brooks).

A pair was obtained on 9th June. These were the only ones met with.

21. **Suya criniger striatula** (Hume).

Abundant in June and July, when its monotonous 'song' was to be heard on all sides. The organs of specimens obtained were in breeding condition, but only one nest was found. This appeared to be ready for eggs on 18th June, but was subsequently deserted. Seldom seen in September.

22. **Pastor roseus** (L.).

First appeared on the Autumn passage on 27th June, when a fair-sized flock was found resting in some pine trees, and a few were seen about the hill on the two following days. On 5th July numbers were observed in a fruit garden on the Rakhni plain (Loralai) below Khar, where they were attacking the grapes. From the 14th until the end of the month numerous flocks passed over Fort Munro every morning from West to East. They were

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swarming on the date palms and devouring the ripe fruit when I passed through the Muzaffargarh District on 4th August.

23. **Urolouncha malabarica** L.

Not seen at Fort Munro, but two were obtained at Khar on 28th July. These Munias were exceedingly numerous in a fruit garden at Rakhni on 5th July.

24. **Passer domesticus** sub-sp.?

Common on each of my visits, nesting in buildings in June and July. Very partial to the fruit of the few mulberry trees in the place.

[The two males measured, wings 75 and 75-5 mm., can only be attributed to the race *indicus*, to which also I should therefore attribute two males from Loralai with wings of 77 mm.]

25. **Emberiza stewarti** Blyth.

Met with in small numbers at Fort Munro and the garden at Khar in September.

26. **Emberiza bruniceps** Brandt.

A small party of what appeared to be Red-headed Buntings rested in a bush a few yards from me on 23rd July, but were off again before I had time to secure a specimen.

27. **Emberiza striolata striolata** (Licht.).

First seen on 18th July when a male appeared in the compound of my bungalow. By the end of the month these birds had become fairly common, and their cheery little 'song' was frequently to be heard on the hill-sides. The testes of males obtained were greatly enlarged.

28. **Krimnochelidon obsoleta pallida** Hume.

Observed from time to time, singly or in pairs, throughout June and July. From the organs of specimens obtained they appeared to be breeding, but I failed to find any nests. Noted as common in September, occasionally nesting on the roof cornices of buildings.

[These birds seem to bleach rapidly and most skins in collections are poorly made and greasy. From the series I have been able to examine I am by no means satisfied that birds from the north-west frontiers of India are separable from those of north-east Africa.]

29. **Hirundo daurica scullii** Seebohm.

Common in June and July, nesting in the roofs of bungalow verandahs and out-houses. Slightly incubated eggs were taken on 13th June, 14th July, and 2nd August, the clutch numbering two or three. Nests broken open were repaired and more eggs laid. Not noted in September. 5 specimens were obtained and are those referred to by Ticehurst in his note on this bird (*Ibis* 1933, p. 547).

30. **Motacilla cinerea caspica** S. G. Gmelin.

A few were observed in the neighbourhood of the tanks in September. A solitary wagtail seen in a torrent bed on 24th July was almost certainly of this species.

31. **Anthus trivialis trivialis** (L.).

A few were met with on passage in September.

32. **Anthus sordidus decaptus** Meinertzhagen.

Common on each of my visits. Nests were found with two downy young on 3rd June, c/3 hard-set on 4th June and c/3 hard-set on 18th June. Many young birds were seen throughout June and July.

33. **Oreocorys sylvanus** (Hodgs.).

Only met with on the northern face of a steep hill immediately to the West of Fort Munro. A juvenile was secured at the end of June and three adults in the first-half of July, one unsexed and the other two males with organs in breeding condition. The curious call was usually uttered from the tops of large boulders and was very difficult to locate.

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[A welcome record as very little is known of this species in this area. The adults sent appear somewhat paler than Himalayan birds but they are very worn and this may be only due to bleaching.]

34. **Galerida cristata magna** Hume.

Observed occasionally on each of my visits. Adults were seen feeding young birds at the beginning of June.

[Four adult males obtained at Fort Munro are definitely assignable to this race with wing measurements 108-114 mm. It is interesting to note, however, that two other males from Badin, Loralai Agency, are smaller, wings 105.5-106 mm.]

35. **Ammomanes deserti phoenicuroides** (Blyth).

Observed occasionally on each of my visits. Young birds were met with in June and an adult was seen carrying food on the 6th of that month.

[Two adult ♂s have the wings 101·5 and 106 mm. respectively, showing that these birds are typical *phoenicuroides*, like the Sibi, Bolan Pass and Fort Sandeman birds mentioned by Ticehurst (*J.B.N.H.S.*, xxxi, 876). The two juveniles have the longer, broader and blunter first primary than the adult as noted by Ticehurst (*Ibis* 1923, p. 20). In colour they agree with adults, but the feathers of the upper parts show indistinct subterminal dark bars and pale tips. The primary and greater coverts, the wing and tail quills have the pale edges broader than in adults and more rufous in colour.]

36. **Leptocoma asiatica brevirostris** (Blanf.).

Only once observed at Fort Munro, a female on 18th July. A pair was seen in a fruit garden on the Rakhni plain on 5th July.

37. **Coracias garrula semenowi** Loud and Tschusi.

Appeared on passage at the end of July when one or two were seen at Fort Munro and Khar.

38. **Upupa epops epops** L.

A few were met with at Fort Munro and Khar at the end of July.

39. **Micropus melba melba** (L.).

Two or three were seen hawking in company with *Hirundo daurica* on 21st, 25th and 28th July and 2nd August. Not noted in September. No specimen obtained.

40. **Micropus affinis galilegensis** (Ant.).

A few were observed in company with *Hirundo daurica* on two occasions in the middle of July and again at the beginning of August. Not noted in September.

[The single ♂ obtained, wing 132, evidently belongs to this race.]

41. **Caprimulgus europaeus unwini**, Hume.

Throughout the latter half of June two or three of these Nightjars were to be seen regularly at dusk hawking in the vicinity of the bungalows. One was shot on 28th June.

[An unusually silvery specimen compared with the majority of examples of this form.]

42. **Aegypius monachus** (L.).

A pair of very dark vultures seen on 12th June were possibly of this species.

43. **Gyps** sp.?

Griffons of sorts were noted on three occasions in June.

44. **Pseudogyps bengalensis** (Gm.).

Twice seen in June, once in a party of about half a dozen.

45. **Neophron percnopterus percnopterus** (L.).

Common on each of my visits. It presumably breeds in the cliffs round about and a number of young birds were noted.

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46. **Gypaetus barbatus hemachalanus** Storr.

One or more of these grand birds were frequently observed throughout June and July, often flying quite low over the hill-side and coming within a few yards of one.

47. **Cerchneis tinnunculus** sub-sp.?

A pair of Kestrels was observed, either singly or together, almost daily throughout June and again at the end of July, occasionally being mobbed by Ravens. Several were met with in the garden at Khar in September, when a male was secured.

[This male, wing 249 mm., is a very pale immature bird but I should not like to say to what race it belongs. See *Ibis* 1923, p. 261.]

48. **Aquila heliaca heliaca** (Savigny).

An eagle seen perched on a large boulder at the end of July was possibly a young bird of this species.

49. **Milvus migrans govinda** Sykes.

One or more of these kites were scavenging round the hill throughout June and July.

50. **Accipiter nisus melanoschistus** Hume.

Only met with once, on 24th September, 1930, when a female was shot in a small plantation of pines near Dames' tank.

51. **Streptopelia senegalensis cambayensis** (Gmel.).

A few pairs were constantly met with throughout June and July. This Dove and *S. d. decaocto* were common on the Rakhni plain in June, but the latter apparently does not ascend to Fort Munro.

[Two males collected at Fort Munro and Badin, Loralai, have the wings respectively 130 and 131·5 mm.]

52. **Coturnix coturnix coturnix** (L.).

One was flushed from the hill-side on 17th June. I had previously put one up from the bank of a stream on the Rakhni plain on the 12th.

53. **Alectoris graeca** sub-sp.?

A small covey was seen on two occasions at the end of June and a pair on the 15th July, but I did not succeed in obtaining a specimen.

54. **Francolinus pondicerianus** sub-sp.?

Grey Partridges were heard calling round Khar in June and July. Several were seen by the road-side when motoring over the Rakhni plain in June. No specimen obtained.

55. **Tringa ochropus** L.

What appeared to be a Green Sandpiper was noticed at one of the tanks on the 12th July, but it flew off before I got near and was not seen again.

56. **Tringa hypoleucos** L.

A party of three was found on one of the tanks on 24th July. They were extremely wild, and I with difficulty secured a female, which was loaded with fat.

57. **Lobipes lobatus** (L.).

A small flock was met with on Trimmu tank on 25th September, 1930. They were remarkably tame and showed little signs of alarm even after a pair had been shot.

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NOTE ON A PYRALID (*ARGYRIA FUSCIVENALIS* Hmp.), CATERPILLAR PEST OF *CRATAEVA RELIGIOSA* Forst.

BY

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(*With a plate*).

Introduction.—The present paper deals with *Argyria fuscivenalis,* Hmp., a serious pest of *Crataeva religiosa,* Forst., an ornamental tree found in Coimbatore and its environs. An account is given of the life history and habits of this insect together with the control methods for the same.

Life history.—The adult moths (Fig. 7) measure 6 mm. long with a wing expanse of 13 mm. They have pale yellow forewings and pale white hind wings. There are two dark wavy lines on each of the forewings. The adults have got the peculiar habit of resting on leaves with their heads directed downwards. Moths kept in captivity were found to feed freely on jaggery water. Longevity records of the moths (Table I) show that one moth topped the list with 24 days while the average period for 23 moths was 12 days.

Eggs are generally laid 2 days after the emergence of moths. One female laid as many as 225 eggs in 11 days (Table II). For egg laying the female prefers infested leaves (Fig. 1) with webs on them. Eggs are either laid on these webs or on portions of leaves from which the green matter has been scraped off by young caterpillars. The newly laid eggs (Fig. 2) are pale yellow in colour and roughly oval in shape measuring 0·5 mm. long. On the second day the colour of the egg changes and three transverse bars (Fig. 3) pinkish in colour are noticed on the egg. The egg period is 3 to 4 days.

The newly hatched larvae (Fig. 4) are 1 mm. long and 0·2 mm. broad, pale yellow in colour with black head capsule and white hairs all over the body. They begin to make webs and feed under cover of these and undergo four months in all before pupation (Table III). When they are full fed (Fig. 5) they measure about 3 mm. long and 2 mm. broad and have two dorsal longitudinal lines of violet colour. On every segment are seen triangular black spots with their bases touching the lines. White hairs are also seen on the body. The larval period is 12-13 days.

The caterpillars when full fed make silken cocoons and pupate inside hese. The pupae (Fig. 6) are deep brown in colour and measure about mm. long and 2 mm. broad. The pupal period is 9-10 days.

The whole life cycle lasts 23-27 days (Table IV).

Parasites.—Three parasites have been noticed on the caterpillars one of which is *Apanteles creatonot* (Fig. 8) and the other two *Heterogamus* sp. and un unidentified Ichneumonid. These however are not found in large numbers as to check the pest.

Remedial measures.—Spraying with Lead arsenate at the rate of half an ounce to one gallon of water has been found to be useful against the pest. In the case of small trees hand picking of the caterpillars may be tried with advantage.

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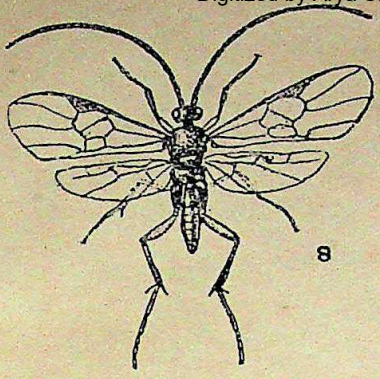
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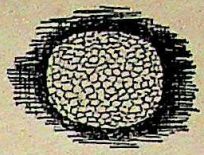
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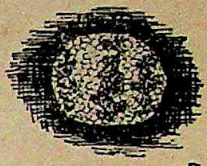
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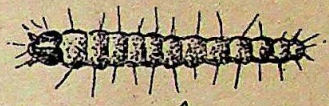
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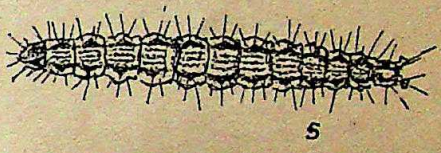
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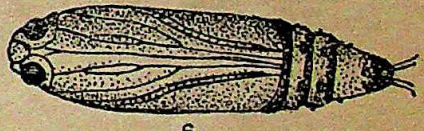
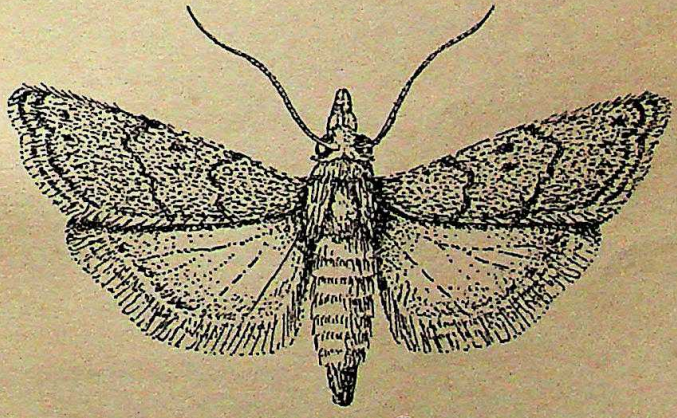

6


7

Argyria fuscivenalis, Hmp.

1. *Crataeva religiosa* (attacked leaf).
2. Egg (newly laid).
3. Egg (second day).
4. Young caterpillar.
5. Full grown caterpillar.
6. Pupa.
7. Adult moth.
8. Parasite.

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TABLE I.

Longevity records of adults.

No.	No. of moths.	Emerged.	Died	Total No. of days alive.	Remarks.
1	1	25- 7-27	18- 8-27	24	
2	2	26- 7-27	16- 8-27	21	♂
			18- 8-27	23	
3	2	27- 7-27	6- 8-27	10	
			9- 8-27	13	
4	2	29- 7-27	3- 8-27	5	
			6- 8-27	8	♀
5	2	1- 8-27	10- 8-27	9	
			12- 8-27	11	
6	1	23- 9-27	9-10-27	16	
7	2	23- 9-27	5-10-27	12	♀♀♀♀♀♀♀
			8-10-27	15	
8	1	27- 9-27	3-10-27	6	
9	1	17-10-27	24-10-27	7	
10	1	19-10-27	25-10-27	6	
11	1	20-10-27	10-11-27	21	
12	1	20-10-27	2-11-27	13	
13	1	21-10-27	12-11-27	22	♂♂♂♂♂♂♂♂♂
14	1	15-11-27	25-11-27	10	
15	1	16-11-27	25-11-27	9	
16	1	17-11-27	24-11-27	7	
17	1	17-11-27	24-11-27	7	
18	1	18-11-27	25-11-27	7	

TABLE II.

Egg-laying record of a female moth.

Date		No. of eggs
23- 9-27	...	♂ & ♀ emerged and kept for egg laying.
25- 9-27	...	2 eggs.
26- 9-27	...	42 ,,
27- 9-27	...	15 ,,
28- 9-27	...	19 ,,
29- 9-27	...	16 ,,
30- 9-27	...	55 ,,*
1-10-27	...	34 ,,
2 & 3-10-27	...	27 ,,
4-10-27	...	6 ,,
5-10-27	...	9 ,, (♂ died).
8-10-27	...	♀ died.
Total No. of eggs	...	225

* Of this number only 18 were freshly laid eggs while 37 found on the cotton wool placed in the rearing jars may have been laid probably two or three days previously.

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TABLE III.

Records of detailed life history observations.

Particulars.	A	B	C
Egg found laid	26-9-27	22-10-27	22-10-27
Egg found hatched	29-9-27	25-10-27	25-10-27
Moulted I	1-10-27	27-10-27	27-10-27
Moulted II	3-10-27	29-10-27	29-10-27
Moulted III	5-10-27	31-10-27	31-10-27
Moulted IV	7-10-27	2-11-27	2-11-27
Cocooning	10-10-27	4-11-27	5-11-27
Pupated	12-10-27	6-11-27	8-11-27
Adult emerged	20-10-27	16-11-27	17-11-27
Total life cycle ...	24 days	25 days	26 days
Sex ...	♀	♂	♀

TABLE IV.

Table of life history records.

Serial number.	Egg found laid.	Egg found hatched.	Duration of egg period in days.	Date of cocooning.	Duration of active larval life in days.	Found pupated.	Duration of larval period in days.	Adult emerged.	Duration of pupal period in days.	Total life cycle in days.	Sex.
1	26-9-27	29-9-27	3	10-10-27	11	12-10-27	13	20-10-27	8	24	♀
2	,,	,,	3	,,	11	,,	13	,,	8	24	♂
3	,,	,,	3	,,	11	,,	13	,,	8	24	♂
4	,,	,,	3	,,	11	,,	13	,,	8	24	♂
5	,,	,,	3	,,	11	,,	13	21-10-27	9	25	♀
6	,,	,,	3	,,	11	,,	13	19-10-27	7	23	...
7	22-10-27	25-10-27	3	7-11-27	13	...	...	18-11-27	...	27	♀
8	,,	,,	3	4-11-27	10	6-11-27	12	16-11-27	10	25	♂
9	,,	,,	3	5-11-27	11	8-11-27	14	17-11-27	9	26	♀
10	,,	,,	3	4-11-27	10	6-11-27	12	15-11-27	9	24	♀
11	,,	,,	3	5-11-27	11	8-11-27	14	17-11-27	9	26	♀

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NOTES ON SOME SOUTH INDIAN SYRPHIDS.

BY

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Introduction.—Syrphids, commonly known as 'Hover flies' or 'Sun flies', play an important part in checking one of the worst insect pests of cultivated crops, viz., Aphids and as such these are very valuable to the farmer. Along with Lady birds (*Coccinellidae*), Lace wings (*Chrysopidae*) and Leucopis flies (*Argomyzidae*) these prey upon Aphids and destroy them in numbers. Though in other countries a few have been noted as pests yet in India this has not been the case. The present paper is an attempt to bring together information regarding the distribution of species, hosts etc. of the South Indian forms. The description and life history notes are the writer's own but information gathered from the labels of the Coimbatore collections while the writer was the Assistant Entomologist has also been included. The thanks of the writer are due to the Director, Imperial Institute of Entomology, London, for identifying some of the specimens included in the list.

Description of Adults and General Life History.—Adult flies are generally brightly coloured with bands of yellow and black predominating. This colouring gives them the resemblance to wasps. The 'false vein' is an important character of the family. While the adult flies feed on the nectar of flowers the maggots have varied habits. Some of these are predaceous on Aphids; others are found living in decaying organic matter and yet a third group consists of plant feeders.

Classification.—The classification followed is that adopted by Verrall and used by Brunetti in the Fauna of British India series. Of the seven sub-families included in the Fauna viz., *Syrphinae, Eristalinae, Milesiinae, Chrysotoxinae, Volucellinae, Microdontinae* and *Ceriinae*, the first four alone are represented in the list. The various Syrphids met with in South India are arranged under their respective sub-families.

SUB-FAMILY: SYRPHINAE.

1. *Paragus serratus*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 31.

Life history and habits.—Eggs are laid by female flies on plants infested with Aphids. These are white and oval and measure about 0.75 mm. long. The newly hatched maggots have stiff black hairs all over the body. They feed on Aphids by sucking out their body contents. The maggots are known to attack both root and shoot infesting aphids. In the case of those feeding on root infesting forms the colour of the maggot is generally pale white. Those which feed on Aphids on shoots have generally bright colours. The pupae, about 5.5 mm. long, are found on the leaves. The pupal period lasts 7 to 8 days. The longevity of two adults fed on jaggery-water in captivity came to 5 and 11 days respectively.

Food.—Maggots have been noted feeding on Aphids on *Cholam* and *Ragi* both on the shoot and root forms. Also on Aphids on Sweet potato and water melon.

Distribution.—The Coimbatore collection contains specimens from Coimbatore; Hadagalle (Bellary); Samalkota (Godavari) and Ramnad.

Remarks.—This is a common species found in Coimbatore along with *Ischiodon scutellaris*. The presence of the serrated scutellum is one of the most important characters of the fly.

2. *Ischiodon scutellaris*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*. vol. iii, p. 97.
Lefroy, *Indian Insect Life*, Plate lxiv, p. 611.
Fletcher, *Some South Indian Insects*, Plate xv, p. 358.

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Life history and habits.—The habits are similar to those of Paragus. Two forms of maggots noticed are those with green colour and those with bright colours. The latter look like those of Paragus but the brightly coloured transverse bar about the middle of the body found in Paragus is absent. The larval period is about 5 days and the pupal period about 5 to 6 days. The maximum longevity in the case of a fly fed with jaggery water in captivity came to 17 days. Three females laid 154 eggs between them.

Food.—Maggots have been noted feeding on Aphids on red gram, cholam, Calotropis sp., water melon and cotton. Adult flies have also been collected resting on brinjal, mustard, turnip, cabbage and groundnut.

Distribution.—Coimbatore; Marudamalai (Coimbatore); Hagari (Bellary); Kallar (Nilgiris); Saidapet (Chingleput); Samalkota (Godavari); Villupuram (South Arcot).

Remarks.—The presence of a slender tooth on the under surface of the hind trochanter is an important mark of the species.

3. *Asarcina aegrota*, F.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 64.
Food.—Maggots were found feeding on the dark brown Aphids on citrus.
Distribution.—Coimbatore.

4. *Asarcina cricetorum*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 63.
Food.—Adults found resting on cholam leaves.
Distribution.—South Canara; Coimbatore; Bellary; Godavari; Chepauk (Madras).

5. *Syrphus balteatus*, De Geer.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 82.
Food.—Maggots found feeding on Aphids on *Arundo donax* and certain grasses.
Distribution.—Salem; South Canara; Coimbatore; Malabar; Kallar (Nilgiri Hills); Yercaud (Salem) and Maruthamalai (Coimbatore).

6. *Sphaerophoria javana*, Wied.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 100.
Distribution.—Maruthamalai (Coimbatore).

7. *Baccha nubilipennis*, Aust.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 116.
Distribution.—South Canara.

8. *Baccha triangulifera*, Aust.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 124.
Distribution.—South Canara.

9. *Baccha sapphirina*, Wied.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 122.
Food.—Predaceous on Psyllid bugs.
Distribution.—Coimbatore.

Sub-Family: Eristalinae.

10. *Eristalis arvorum*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 181.
Distribution.—Coimbatore; Devakonda (Kurnool); Hadagalle (Bellary); Amalapuram (Godavari); Madanapalle (Chittoor).

11. *Eristalis multifarius*, Walk.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 194.
Distribution.—Coimbatore.

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12. *Eristalis laetus*, Wied.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 165.
Distribution.—Bababudin hills (Mysore).

13. *Eristalis obscuritarsis*, deMeij.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 190.
Distribution.—Kurnool.

14. *Eristalis quinquestriatus*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 187.
Distribution.—Bababudin hills (Mysore).

15. *Eristalis quinquelineatus*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 183.
Distribution: Yercaud (Salem).

16. *Megaspis crassus*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 197.
Food.—Flies collected resting on safflower.
Distribution.—Coimbatore; Kurnool; Amalapuram (Godavari); Saidapet (Chingleput).
Remarks.—A tooth on the hind femora is an important mark of the species.

17. *Megaspis errans*, Fabr.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 199.
Food.—Adults collected resting on manure heap, safflower, cholam and sugarcane.
Distribution.—Coimbatore; Amalapuram (Godavari); Hadagalle (Bellary); Devakonda (Kurnool); Madanapalle (Chittoor).

18. *Megaspis argyrocephalus*, Macq.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 201.
Distribution.—Coimbatore.

SUB-FAMILY: MILESIINAE.

19. *Xylota bistriata*, Brun.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 238.
Food.—Adults collected resting on coffee flowers.
Distribution.—North Coorg.

20. *Xylota carbonaria*, Brun.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 240.
Distribution.—Yercaud (Salem).

21. *Syritta rufifacis*, Big.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 247.
Food.—Maggots found feeding on Aphids on mango flowers.
Distribution: Coimbatore.

22. *Syritta pipiens*, L.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 245.
Food.—Maggots in rotting paddy, rotting ash gourd.
Distribution.—Coimbatore; Bellary; Madanapalle (Chittoor).

23. *Eumerus albifrons*. Walk.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 257.
Food.—Adults resting on castor and water melon leaves.
Distribution.—Salem; Coimbatore.

SUB-FAMILY: CHRYSOTOXINAE.

24. *Chrysotoxum baphyrus*, Walk.

Reference.—Brunetti, *Fauna of British India, Diptera*, vol. iii, p. 296.
Distribution.—Yercaud (Shevroys).

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AN ANNOTATED LIST OF INDO-CEYLONESE TERMITES

BY

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The Termites or 'white ants' are a group of insects which have not received enough attention during recent years. They are of great economic importance, in view of their ravages to wooden structures, cotton and woollen clothings, books, etc., not to speak of their damage to cultivated crops such as sugarcane, tea, wheat etc.

The earliest known observations on termites were made on South Indian termites by Koenig about 150 years ago, which centred about Tanjore and Nagari hills.[1] He has given an anatomical account of the different castes and has made mention of *Hodotermes viarum* Koenig, *Termes convulsionarius* Koenig and a species of *Eutermes* which, according to him, is similar to the one noted by him in Ceylon later. In this connecton, Fletcher is of opinion that the species Koenig refers to as *Eutermes monoceros*,—the 'black termite' of Ceylon, is different and the latter has not been recorded in India. Since that time collections were made by several and specimens were sent outside for identification. Father Assmuth from Bombay sent collections to Dr. Holmgren of Stockholm with very interesting observations and the results were published in the Bombay Journal.[2] The same writer has also published an account on the wood destroying white ants in the same journal.[3] In South India impetus to the study of white ants was given by Mr. Bainbrigge Fletcher whose keen interest on this group of insects is well known; and a good collection of termites of South India was made by him and sent to Dr. Holmgren, the results of which have found a place in one of the Pusa Memoirs.[4] Late Dr. Annandale of the Indian Zoological Survey collected some material from the Barkuda Island, Chilka Lake and the material was examined by Silvestri and recorded in the Records of the Indian Museum.[5] In addition to these, there are several earlier records of Indian termites by Desneaux, Wasmann and others.

The classification adopted in this list is that of Dr. Holmgren which is so far the simplest in the present state of our knowledge

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[1] Koenig, 1779, Naturgeschichte der sogenannte weissen Ameisen; Besch. der Berlin. Ges. naturforsch. Freunde, T. iv, pp. 1-28.

[2] Holmgren, N., 1912, *J. Bomb. Nat. Hist. Soc.*, xxi, 774-793.
1913, *J. Bomb. Nat. Hist. Soc.*, xxii, 101-117.

[3] Assmuth, A. J., 1913, *J. Bomb. Nat. Hist. Soc.*, xxii, 372-384.
1915, *J. Bomb. Nat. Hist. Soc.*, xxiii, 690-694.

[4] Holmgren, N., 1917, *Mem. Dept. Agr. India*, Ent. Ser. v, 138-171.

[5] Silvestri, F., 1923, *Rec. Ind. Mus.*, xxv, 221-232.

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of the Indo-Ceylonese forms. The oldest classification has been retained in order to avoid confusion, as the classification of this group requires careful handling. It is the considered opinion of the writer that the classification may be changed as more and more material of the different forms are examined and studied.

Some years back, the writer had occasion to deal with termites that cause damage to sugarcane and in that connection undertook a study of this group since then. As time permitted, the available literature has been gathered and the known species have been arranged in the form of a list in the hope that this will form a basis for study to those interested in this highly economic group. It is with this object this list has been prepared. In so doing, it is not presumed that this is a complete one. It cannot but have several drawbacks as most of the literature is in foreign languages and not easily accessible.

A study of the termite fauna of India will not be complete unless a study of the Ceylonese forms is also made and with this object Indo-Ceylonese forms have been given in this list. The writer had to depend mainly on Mr. Green's catalogue of Ceylonese forms.[1]

In order that the list may be of some use and to make it interesting, instead of making it merely bibliographical, such useful information as the nature of damage they cause, the localities where they were recorded and observations made by collectors and any additional information which may be of systematic importance have also been given.

The writer wishes to express his thanks to Rao Sahib Y. Ramachandra Rao, now Locust Research Entomologist, for having given him an opportunity to study these insects and to Dr. T. V. Ramakrishna Ayyar, Government Entomologist, Coimbatore, for affording all facilities in the continuance of this study and for going through the manuscript.

ORDER: ISOPTERA.

FAMILY: *PROTERMITIDAE*, HOLMGREN.

SUB-FAMILY: HODOTERMITINAE, Holmgren.

Hodotermes, Hagen.

Hodotermes viarum, Koenig, Fletcher, Bull. Dept. Agr. India, No. 100, p. 216 (1921). 'Commonly occurring at Coimbatore doing some damage to grass lawns by cutting off grass.'

Sub-genus: *Acanthotermes*, Sjost.

Hodotermes (*Aacnthotermes*) *kocnegi*, Holmgren, Mem. Dept. Agr. India, Ser. v, No. 3, pp. 138-139 (August 1917). Species described and recorded from Coimbatore, South India. 'Extracted from tunnels in the ground.'

Hodotermes (*Acanthotermes*) *macrocephalus*, Desneaux, Ann. Soc. Ent. Belgique, xlix, pp. 344-348 (1905). Species described and recorded from Sind, India; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 139 (August 1917). Also recorded from Sind, India.

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[1] Green, E. E., 1913, *Spolia Zeylanica*, *Ceylon*, ix, 7-15.

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SUB-FAMILY: CALOTERMITINAE, Holmgren.

Calotermes, Hagen.

Calotermes domesticus, Haviland, Jl. Linn. Soc. London, xxvi, p. 374 (1898); Green, Spolia Zeylanica, ix, pt. xxxiii, p. 8 (June 1913). 'In window and door frames of buildings, in furniture, shelves of almirahs etc. The presence of this species is indicated by small heaps of egg-like pellets of excreta which collect below the articles that contain the termites. Occasionally the insects emerge from the wood and are found congregated in masses in the open.' Recorded from Peradeniya, Ceylon.

Calotermes greeni, Desneaux, Ann. Soc. Ent. Belgique, li, pp. 388-389 (1907). Species described; Green, Spolia Zeylanica, ix, pt. xxxiii, p. 8 (June 1913). Green records in stems of living tea bushes, in stems of *Anacardium* and other trees, occurring more commonly at lower elevations, from Ambalangoda, Kalutara, Yatiyantota, Jaffna, and from Peradeniya in Ceylon; Hutson, Tropical Agriculturist, lix, pp. 83-87 (February 1923). Notes on termites attacking tea and their control are given. Recorded from Ceylon; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 382-383 (1926). Briefly described and recorded from dead stems of Grevillea, stem and roots of tea, and living tea bush, from Ceylon; Jepson, Tropical Agriculturist, lxvii, pp. 77-78 (August 1926). Deals with the control of the insect attacking tea bushes along with *C. militaris* in Ceylon; Dept. of Agriculture, Ceylon, Leaflet No. 24, giving notes on termites attacking tea, their habits and control, recorded from Ceylon.

Sub-genus: *Glyptotermes*, Froggatt.

Calotermes (*Glyptotermes*) *ceylonicus*, Holmgren, Escherich's Termitenleben auf Ceylon, p. 189 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 8 (June 1913). 'In decaying logs and branches.' Recorded from Peradeniya, Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, pp. 279-280 (January 1913). Imago and soldiers described. Imagines of *C. ceylonicus* and *C. dilatatus* compared. Also recorded from Peradeniya.

Calotermes (*Glyptotermes*) *coorgensis*, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 139-140 (August 1917). 'Tunnelling in the still solid wood of an old log of red cedar.' Recorded from Coorg, Sidapur, 3,500 ft., India.

Calotermes (*Glyptotermes*) *dilatatus*, Bugnion & Popoff. Bugnion, Mem. Soc. Zool. France, xxiii, pp. 137-143 (1910). Describes and figures as found in a tea stump at Ambalangoda, Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, p. 278 (January 1913). Imago described from Peradeniya; Hutson, Tropical Agriculturist, lix, pp. 83-87 (February 1923). Notes on termites attacking tea and their control are given. Also recorded from Ceylon; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 383-384 (1926). Species briefly described. Recorded from Ceylon, found in living tea bush, stem and roots of tea; Jepson, Tropical Agriculturist, lxvii, pp. 69-79 (August 1926). Notes on the species of the genus attacking tea bushes, nature of injury, extent of damage, control etc. given. Recorded from Ceylon; Jepson, Tropical Agriculturist, lxxii, pp. 307-311 (1929). Recorded as attacking living plants in Ceylon. Deals with control; Dept. of Agriculture, Ceylon, Leaflet No. 24. Gives notes on termites attacking tea with their habits and control.

Sub-genus: *Neotermes*, Holmgren.

Calotermes (*Neotermes*) *assmuthi*, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 102-103 (April 1913). Species described. 'Termites in dry trunk of tree in garden. Tunnels built irregularly in wood and these, strange to say, altogether without inner lining of earthy material as is usually the case with termites.' Bangalore, India. Holmgren says that the said lining of tunnels is very often wanting with *Calotermes*, a species frequently found on living trees.

Calotermes (*Neotermes*) *fletcheri*, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 139 (August 1917). Recorded from Coimbatore, South India.

Calotermes (*Neoteremes*) *militaris*, Desneaux, Ann. Soc. Ent. Belgique, xlviii. p. 146 (1904). Species described; Green, Spolia Zeylanica, ix, pt. 33, p. 7 (June 1913). 'In stems of living tea throughout the tea districts of Central

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Provinces; collected also in the Ratnapura District.' Recorded from Ceylon; Green, Tropical Agriculturist, xxviii, pp. 181-183 (March 1907). Here he gives an account of the nature of injury done to tea bushes, the extent of damage, the habits of the termite and control measures to be adopted; Holmgren, Spolia Zeylanica, viii, pt. 32, pp. 277-278 (January 1913). The imago described. Recorded from Peradeniya; Hutson, Tropical Agriculturist, lix, pp. 83-87 (February 1923). Notes on termites attacking tea, their habits and their control given. Recorded from Ceylon; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 380-381 (1926). Species briefly described, from tea bushes, branches of tea and stems and roots of tea, recorded from Ceylon; Jepson, Tropical Agriculturist, lxvii, pp. 69-79 (August 1926). Deals with host plants in Ceylon, nature of injury to tea bushes and extent of damage and control; Jepson, Tropical Agriculturist, lxxii, pp. 307-311 (1929). Deals with the control of termites attacking living plants in Ceylon; Dept. of Agriculture, Ceylon, Leaflet No. 24. This deals with notes on termites attacking tea, their habits and control in Ceylon.

Calotermes militaris ab. unidentatus, Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 381-382 (1926). Species described, from branches, stems and roots of tea in Ceylon.

FAMILY: *MESOTERMITIDAE,* HOLMGREN.

SUB-FAMILY: LEUCOTERMITINAE, Holmgren.

Leucotermes, Silvestri.

Leucotermes ceylonicus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 190 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 8 (June 1913). 'A troublesome domestic pest, destructive to wood work, packing cases etc., in outhouses: also in a dead Grevillea stump: from Peradeniya. Ceylon.'

Leucotermes indicola, Wasmann, Zool. Jahrb., p. 118 (1902). Recorded from Bombay, India; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, p. 776 (July 1912). 'From the Chemical Laboratory of St. Xavier's College room on ground floor; the termites seem to have come out from underground and had almost completely eaten up several boxes of dealwood of which they are specially fond; caught by lamplight in room.' Recorded from Bombay, Khandala; Holmgren, Jl. Bomb. Nat. Hist. Soc. xxii, No. 1, p. 103 (April 1913). 'In pillars of mound of *O. obesus,* in middle of nest, quite close to royal cell.' Recorded from Borivli near Bombay; Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2, pp. 372-384 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 140 (August 1917). Recorded from Punjab, Dhar (Gurdaspur District), India.

Arrhinotermes, Wasmann.

Arrhinotermes flavus, Bugnion, Mem. Soc. Zool. Fr., xxiii, p. 117 (1907); Green, Spolia Zeylanica, ix, pt. 33, p. 9 (June 1913). 'Discovered by Dr. Bugnion in stems of mangrove, Ambalangoda' in Ceylon.

Arrhinotermes heimi, Wasmann, Zool. Jahrb. Syst., xvii, p. 104 (1902). Species described and noted from Ceylon.

SUB-FAMILY: COPTOTERMITINAE, Holmgren.

Coptotermes, Silvestri.

Coptotermes ceylonicus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 192 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 9 (June 1913). 'Commonly under decaying logs of wood; also about buildings, where it is destructive to deal packing cases; recorded as damaging books, in damp situations, the wood of tea chests and window frames in a tea factory; Peradeniya, Matala, Lindula, Nalanda, Trincomalee, Rattota, Ratnapura, Henaratgoda, Ambalangoda and Jaffna' in Ceylon; Holmgren, Termitenstudien, iv, p. 76 (1913); Kemner, Bull. Ent. Res., xvi, pt. 4, p. 384 (1926). Brief description given and recorded from Ceylon in dealwood, rafters of bungalow, and dead bark of *Hevea;* Jepson, Tropical Agriculturist, lxxii, pp. 308-309 (1929). Recorded as attacking living plants from Ceylon and deals with control.

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Coptotermes gestroi, Wasmann, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 145 (August 1917). Recorded from Assam, India. 'In mound and wood in wall.'

Coptotermes heimi, Wasmann. Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, pp. 777-778 (July 1912). Other species of the genus compared and obtained by lamplight, on footpath and in room in wooden shelves partly eaten up. Noted from Bombay, India; Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 144-145 (August 1917). Noted in various parts of India viz., Punjab, Bihar, Bengal, Madras, Coorg etc., with varying habits such as under galleries, on bark of Ficus, under log, running galleries into stem of mango tree, attacking wood of old cement-barrel filled with earth and used as a flower pot etc.; Silvestri, Rec. Ind. Mus., xxv, p. 225 (1923). 'Collected under the bark of dead tree trunk (*Ficus bengalensis*) lying on the ground. Widely distributed in South India.' Barkuda Island, Chilka Lake, India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Coptotermes parvulus, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, p. 104 (April 1913). Species described. Recorded from Guzerat, India, on trunks of trees and in dry firewood. Also recorded from Anand and Vadtal. Holmgren says that some *Coptotermes* dwell in live trees and thinks that this species is close to the Indo-Chinese *C. travians*; Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2, pp. 372-384 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Silvestri, Rec. Ind. Mus., xxv, p. 225 (1923). 'Workers and soldiers.' Recorded from Barkuda Island, Chilka Lake, India; Annandale, Rec. Ind. Mus., xxv, pp. 233-235 (1923). Nesting and swarming habits given.

Coptotermes travians, Haviland, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 145 (August 1917). 'In galleries run over tarred beams in a house' and 'under galleries on bark of Ficus.' Recorded from Bengal, India; Bugnion, Mem. Soc. Zool. Fr., pp. 109-123 (1910). Recorded from Ceylon.

Termitogeton, Desneaux.

Termitogeton umbilicatus, Hagen, Zool. Bot. Ver. Wien, p. 472 (1858); Green, Spolia Zeylanica, ix, pt. 33, p. 9 (June 1913). 'A rare jungle species, Hantana (Kandy District), 3,000 ft.; Ramboda, 4,000 ft.,' Ceylon; Bugnion, Ann. Soc. Ent. Fr., lxxxiii, pp. 39-47 (1914). Description and notes given and also recorded from Ceylon.

Stylotermes, Holmgren.

Stylotermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 142-144 (August 1917). 'Burrowing in rotten interior and in sound wood of a mango tree.' Recorded from Shevaroy Hills, about 4,000 ft., South India; Fletcher, Bull. Dept. Agr. India, No. 100, p. 246 (1921).

FAMILY: *METATERMITIDAE*, HOLMGREN.

Termes, Linnaeus.

Termes belli, Desneaux, Ann. Soc. Ent. Belgique, xlix, pp. 352-354 (1904). Species described. Mr. Bell gives a short account of the nest. Recorded from Karachi (Sind), India.

Termes brunneus, Hagen, Linn. Ent. xii, p. 133 (?) ; Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'Soldiers said to be intermediate in size between *horni* and *Ceylonicus*. Precise locality uncertain.'

Termes estherae = (*convulsionarius*), Desneaux, Ann. Soc. Ent. Belgique, li, pp. 390-394 (1907). Recorded from Bippen, Bombay; Green, Spolia Zeylanica, ix, pt. 33, p. 33, p. 11 (June 1913). 'A very large species with soldiers of two or more sizes. Larger soldier with an enormous head and powerful jaws. Hambantota.' Ceylon. Mr. Bainbrigge Fletcher is of opinion that this name will have to give place to *convulsionarius* of Koenig-Schrift Ber. Naturf., iv, pt. 1, p. 24 (1779); Holmgren, Spolia Zeylanica, viii, pt. 32, p. 280 (January

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1913). Recorded from Ceylon; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 145-146 (August 1917). Recorded from various parts of the Madras Presidency from nests in ground. Fletcher and Bugnion art of opinion that this species is identical with *Hodotermes convulsionarius;* but Holmgren thinks that proof for this is wanting.

Termes fatalis, Koenig, Schrift d. Berlin Naturf. iv, p. 1 (1779); Desneaux, Ann. Soc. Ent. Belgique, xlix, pp. 359-360 (1905). Synonymical notes given; Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'Holmgren gives Ceylon as a locality for this species, probably on the authority of Hagen; but he doubts its generic position. It is said to be common mound-building termite of Tanjore, India; and its occurrence in Ceylon is doubtful.'

Termes mycophagus, Desneaux, Ann. Soc. Ent. Belgique, xlix, pp. 348-352 (1905). Species described and recorded from Karachi, Sind, India. Mr. Bell gives a short account about the nest and fungus combs.

Termes preliminaris, Holmgren, Escherich's Termitenleben auf Ceylon, p. 196 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 10 (June 1913). 'While describing this as a new species from winged adults caught' around a lamp at the Peradeniya resthouse Dr. Holmgren suggests that it may possibly be referable to some other species of which the adults are yet unknown.' Recorded from Ceylon.

Termes sindensis, Desneaux, Ann. Soc. Ent. Belgique, xlix, pp. 354-355 (1905). Species described and recorded from Karachi, Sind, India. Mr. Bell adds a note re-nest.

Termes taprobanes, Walker, Cat. Neur. Br. Mus., p. 522 (1853). (Syn. *T. peradeniya*, Holmgren, Escherich's Termitenleben auf Ceylon, p. 197); Green, Spolia Zeylanica, ix, pt. 33, p. 10 (June 1913). 'This species has hitherto been unrecognized by recent workers. Dr. Holmgren has identified specimens from Peradeniya, and Koslanda as referable to this species, but suggests that it is equivalent to *horni*. He also relegates his *peradeniya* (described from winged adults) to *taprobanes*.' Recorded from Ceylon.

Odontotermes, Holmgren.

Odontotermes anamallensis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 157-158 (August 1917). Recorded from 'rotten log by roadside', 3,000 ft.; 'in rotten stump covered with sheets of mud.' Anamalai hills, north slope, about 4,000 ft.

Odontotermes assamensis, Holmgren, Stockholm Vet.-Ak. Handl., 50, No. 2, p. 114, pl. iv, f. 16 and v, f. 15 (1913?). Species new described from Assam, India.

Odontotermes assmuthi, Holmgren, Vet. Ak. Handl., 50, No. 2, p. 140 (1913?). Species described and noted from Bombay; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 112-113 (April 1913). Species described. 'Termites on trunk of tree, in tunnels and covered galleries built of friable greyish-black material.' Recorded from Borivli Jungle, India; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 154-155 (August 1917). Short description given. Noted among dead leaves under rotting branch, attacking a log of *Saissu* (*Dalbergia saissoo*) lying on the ground, and on wing at 9 a.m. after rain; Shevaroy Hills, Coorg, Bihar and Punjab in India.

Odontotermes bangalorensis, Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 112, pl. iv, f. 15 (1913?). Species new, described from Bangalore; Holmgren, (Nec. *Bengalensis*) Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 105-109 (April 1913). Described. A detailed account of the several nests from which the specimens were collected is given by Father Assmuth. Recorded from Bangalore, Krishnarajapuram, Hubli, India; Holmgren, Mem. Dept. Agr. India, Ent., Ser. v, No. 3, pp. 151-152 (August 1917). Noted in cattle dung eating a piece of rope, eating a bamboo 'chick', nibbling roots of cholam (*Andropogon*); galleries over bark of 'babul' tree (*Acacia arabica*) at light and on wing. Recorded from Coimbatore, Shevaroy hills, Bellary, Mysore and Punjab—India; Fletcher, Bull. Dept. Agr. India, No. 100, p. 246 (1921). Recorded from Hadagalli, South India nibbling roots of *cholam*.

Odontotermes bellahunisensis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 150-151 (August 1917). 'Issuing from holes in gravelly soil at dusk', and 'from a hole in ground alongside road just before heavy rain; no mound at all, only one hole of exit.' Recorded from Madras and Mysore.

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Odontotermes ceylonicus, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 113 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 9 (June 1913). 'Intermediate in size between *horni* and *redemenni*. Nests in the ground, without superstructure. Attacks roots of diseased or dying plants and trees. Peradeniya; Yatiyantota; Ratnapura; Balangoda.'—Ceylon; Bugnion, Deutsch Ent. National Bibliothek, ii, pp. 86-96; Bugnion, Rev. suisse de Zool. xix, pp. 383-395 (1911); Holmgren, Spolia Zeylanica, viii, pt. 32, pp. 280-281 (January 1913). Recorded from Peradeniya. '*O. ceylonicus* is readily distinguishable from other Ceylon species by the extensive yellow area surrounding the fontanelle.' The imago is described; Kemner, Bull. Ent. Res., xvi, pt. 4, p. 386 (1926). Briefly described and recorded from tea bush riddled by *Calotermes dilatatus*, in dead bark of *Hevea* (with one soldier of *Coptotermes ceylonicus*) and in dead tea wood.

Odontotermes distans, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 153 (August 1917). Species described. 'Winged imagines caught in a spider's web.' Recorded from Shevaroy Hills, Kadiar Rocks, about 4,000 ft.—India.

Odontotermes escherichi, Holmgren, Escherich's Termitenleben auf Ceylon, p. 195 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 10 (June 1913). 'A small species, occurring in dead tree stems and under decayed logs. Peradeniya.'—Ceylon; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 386-387 (1926). Described from dead stems of *Grevillea* and in soil near dead tea bush, from Ceylon.

Odontotermes facoides, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 156-157 (August 1917). 'Under log lying on ground amongst coffee.' Recorded from Coorg, India.

Odontotermes flavomaculatus, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 150 (August 1917). Described. 'On the wing'. Assam, India.

Odontotermes hornii, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 111 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 9 (June 1913). 'A comparatively large species, common in decaying trees, and in soil treated with cattle manure; nests in the soil without conspicuous mounds; widely distributed; Ruenwella, Avisawlla, Ambalangoda, Hambantota,'—Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, p. 280 (January 1913). Recorded from Peradeniya, Koslanda in Ceylon 'in branches of *Croton tigilum*'. According to Holmgren this is synonymous with *Termes peradeniyae* Holmgren and *Termes taprobanes*?; Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 102-103 (October 1913). Notes on the habits of the species given; Bugnion, Rev. suisse Zool., xxi, pp. 299-330, pls. 3 (1913 ?). Recorded from Ceylon; Kemner, Bull. Ent. Res. xvi, pt. 4, p. 384 (1926). From nests in Ceylon.

Odontotermes horni var. *hutsoni*, Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 384-385 (1926). Fully described. 'In dead coconut log, living tea bush and in roots of cacao.'—Ceylon.

Odontotermes horni var. *minor*, Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 385-386 (1926). Fully described and recorded from dead wood of living tea and dead bark of *Hevea*.—Ceylon.

Odontotermes malabaricus, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 155 (August 1917). Under mud galleries on coconut stems; under log of *Grevillea* lying on the ground. Recorded from Malabar, Shevaroy Hills and Mysore in India.

Odontotermes mirganjensis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 158 (August 1917). 'In rotten branch lying on the ground. Noted from Mirganj in Bengal, India.'

Odontotermes redemenni, Wasmann, Wien. Ent. Zeit., xii, pt. 7, p. 239 (1893); Green, Spolia Zeylanica, ix, pt. 33, p. 10 (June 1913). 'The commonest of the mound-building species in Ceylon. Widely distributed. Kandy, Colombo; Ambalangoda, Trincomalle, Hambantota, Jaffna and probably throughout the island of Ceylon'; Hutson, Tropical Agriculturist, lix, pp. 85-87 (February 1923). Deals with the habits and control of this scavenging termite from Ceylon; Hutson, Tropical Agriculturist, lix, pp. 294-298 (May 1923). Deals with habits, control etc.; Dept. Agr. Leaflet, No. 24.; Annandale, Jl. Bomb. Nat. Hist. Soc., xxx, pt. 1, pp. 25-34 (October 1924). Nest described; Kemner, Bull. Ent. Res. xvi, pt. 4, p. 386 (1926). 'In living tea bush' in Ceylon.

Odontotermes wallonensis, Wasmann, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, no. 1, pp. 109-110 (April 1913). A detailed account of the nests examined

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is given by Assmuth. Recorded from Tuwa (Guzerat), Bangalore, Krishnarajapuram. According to Dr. Holmgren Wasmann considers this species to be a subspecies of *O. obesus* with which the former does not agree but is inclined to group the species with *O. brunneus* which is confirmed by the structure of the nest of both the types; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 152-153 (August 1917). In mounds and under railway sleepers and under logs. Noted from Coimbatore, Bellary Dt., Mysore, Maddur, Bababudin Hills, Kollegal etc., from South India; Poona in Bombay Presidency and Hosangabad in Central Provinces.

Sub-genus: *Cyclotermes*, Holmgren.

Odontotermes (*Cyclotermes*) *brunneus*, Hagen, Linn. Ent. xii, p. 133 (?); Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'Soldiers said to be intermediate in size between *horni* and *ceylonicus*. Precise locality uncertain'; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 783-784 (July 1912). For description vide Hagen's Monographie der Termiten, 1858. 'In dry cow dung completely perforated and traversed with tunnels . . .' from Khandala, India. Also from nest. A complete description of the nest is given by Assmuth. Also from different mounds and nests from different places. From Kirkee and from Poona. Species compared with others of the same genus. Also a note has been appended as regards its affinities with other species; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 153 (August 1917). From an earth mound from Poona in India.

Odontotermes (*Cyclotermes*) *obesus*, Ramb. Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 778-783 (July 1912). In this paper Holmgren divides the species into a, b and c out of the specimens collected from numerous colonies and nests. Comparative measurements are given. All mostly taken from nests at different localities. Nests of these three types are discussed and a note at the end has been appended comparing them with the mound of *O. redemenni*. Localities: Khandala, Borivli Jungle (Salsette Island); Holmgren, Jl. Bomb. Nat. Hist., Soc., xxii, No. 1, pp. 104-105 (April 1913). 'Typical hillock nest. Royal cell in middle of mound slightly higher than the surrounding ground. 1 king and 1 queen. Nests abounding in guests . . .'; also on trunks of trees, in dry cow dung, logs of fire wood, nest under developed cactus shrub, in galleries of earth on *Pipal* tree etc.; Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2, pp. 372-384 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Fletcher, Bull. Dept. Agr. India, No. 100, p. 246 (1921). Recorded from Quilandy, Malabar—damaging young cocconut palms, Coimbatore—galleries on tree trunks, Hadagalli—nibbling bark of small tree, Mysore city—on bark of *Grevillea*, Lyallpur,—on tree trunk, *Bankura*—eating sugarcane setts; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 146-149 (August 1917). Has very wide distribution throughout India of varying habits such as damaging young coconut palms, eating fallen leaves and sugarcane setts, under tree trunks, running galleries on tree trunks, in stumps of *Grevillea*, on Tasmanian railway sleepers etc.; Silvestri, Rec. Ind. Mus., xxv, pp. 223-224 (1923). Briefly described. 'Queen and king from a nest' from Barkuda, Chilka Lake, India; Annandale, Rec. Ind. Mus., xxv, pp. 233-235 (1923). Nesting and swarming habits given.

Odontotermes obesus f. gurdaspurensis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 149-150 (August 1917). 'Swarming from hole in ground, at 9 a.m. after rain.' Gurdaspur, India.

Odontotermes obesus var. *oculatus*, Silvestri, Rec. Ind. Mus., xxv, pp. 224-225 (1923). Described from a nest. Barkuda, Chilka Lake, India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given. Annandale, Jl. Bomb. Nat. Hist. Soc., xxx, pt. 1, pp. 25-34 (October 1924). The nest is described. India.

Odontotermes obesus var. *typicus*, Annandale, Jl. Bomb. Nat. Hist. Soc., xxx, pt. 1, pp. 25-34 (October 1924). The nest described—India.

Sub-genus: *Euscaiotermes*, Silvestri.

Odontotermes (*Euscaiotermes*) *primus*, Silvestri, Rec. Ind. Mus., xxv, pp. 221-222 (1923). A few workers and a soldier under stone. Species described. Barkuda Island, Chilka Lake—India.

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Sub-genus: *Hypotermes*, Holmgren.

Odontotermes (*Hypotermes*) *marshalli*, Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 387-388 (1926). Described from a nest in ground, bamboo fence, and in dead stumps of *Grevillea*—Ceylon.

Odontotermes (*Hypotermes*) *obscuriceps*, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 113 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 10 (June 1913). 'Another common mound-building species. The mounds indistinguishable from those of *redemenni*, but the insects easily recognizable by their dark brown heads. Apparently not so widely distributed as the previous species. Recorded from Peradeniya and Diyatalawa; Holmgren, Termitenstudien, iv, p. 141; Hutson, Tropical Agriculturist,' lix, pp. 85-87 (February 1923). Deals with habits and control of this scavenging termite. Ceylon; Hutson, Tropical Agriculturist, lix, pp. 294-298 (May 1923). Deals with habits and control; Dept. Agr. Ceylon, Leaflet No. 24.

Odontotermes (*Hypotermes*) *xenotermitis*, Wasmann, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 158-159 (August 1917). In mud galleries on tree trunks, under logs and in a pine post. Bengal, Dacca, Assam.

Sub-genus: *Odontotermes*, Holmgren.

Odontotermes (*Odontotermes*) *feae*, Wasmann, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 786-787 (July 1912). 'Eating up books and woollen goods after covering them with friable crusts of red soil. Room on underground floor; termites had come up from underground through crack in cemented pavement.' 'Also under stone, the surroundings of which clearly showed that this is one of the several kinds of white ants which, during nights, cover the surface of ground in neighbourhood of nest with friable galleries and more or less extensive coatings of red earthy material; the termites then eat what they have covered, leaving any portions outside the crust untouched.' These notes are by Father Assmuth. Recorded from Khandala, India; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 110-111 (April 1913). 'Mound described. Imagines swarming at sunset; also from a dry big leaf of fan-palm lying plastered over with tunnels of friable earthy material and eaten up, as far as covered by termites; also in half dry cow-dung completely hollowed out by them.' This note is by Father Assmuth. Recorded from Bombay and surroundings. Holmgren appends a note in which he says that this species of termites closes the nest-openings with a convex cover and is interesting because the South American *Entermes* do the same when walling up the exits of their dwellings; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 156 (August 1917). 'In rotten logs, at light, running mud galleries up trunk of living trees, constructing mud galleries on grass, in dead *Grevillea*, in mud galleries of a mango tree, eating the bark of *Eucalyptus* etc.' Noted from Coimbatore, Coorg, Shevaroy Hills, Bangalore, Mysore, in South India; Dharwar and Belgaum in Bombay; Harra in Bengal; and Maymyo in Burma; Silvestri, Rec. Ind. Mus., xxv, p. 223 (1923). 'Winged specimens, swarming in middle night,' and a few soldiers and workers collected among roots of a dead tree; a few workers found in interior of a dead tree-trunk; species widely distributed in South India.' Barkuda, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Odontotermes (*Odontotermes*) *oblongatus*, Holmgren, Silvestri, Rec. Ind. Mus., xxv, p. 223 (1923). 'A few soldiers and workers collected in a dead tree-trunk,' Barkuda Island, Chilka Lake, South India.

Odontotermes (*Odontotermes*) *parvidens*, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 154 (August 1917). Described. Under logs, in wood and on bark of living *tagar* trees. In South India, Punjab, Bengal and Assam; Fletcher, Bull. Dept. Agr. India, No. 100, p. 245 (1921). 'On the Gauhati-Shillong road as a serious pest of *Cajanus indicus*, eating the roots.'

Microtermes, Wasmann.

Microtermes anandi, Holmgren ?, Stockholm Vet. Ak. Handl., 50, No. 2, p. 152 (1913?). Anand, India. Species described; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, p. 114 (April 1913). Species described. 'Termites together with *O. obesus* in some half-burnt boards of dealwood lying on ground in garden.' This is a note by Assmuth recorded from Anand (Guzerat); Holm-

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gren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 160 (August 1917). Fletcher is of opinion that *anandi* should sink as a synonym of *O. obesi*. Found in logs of wood, under stone, under logs, in dead bamboo, attacking ripening wheat in fields, damaging growing cabbages, eating wood buried under ground, in tree stumps etc., recorded from Coimbatore, Shevaroy Hills, Bellary District, and Mysore in South India; Pusa in Bihar; Mirganj in Bengal; Silvestri, Rec. Ind. Mus., xxv, p. 225 (1923). 'Soldiers and workers in dead tree-trunk, numerous workers and few soldiers in galleries. Widely distributed in South India.' Barkuda Island, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Microtermes anandi forma curvignathus, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, p. 114 (April 1913). Species described from Bombay.

Microtermes globicola, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 116 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'A very small species, constructing chambers and small spherical combs in the walls of mound-building termites. Precise locality undetermined.' Noted from Ceylon; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 159 (August 1917). Noted from under a flower pot in company with Staphylinid beetles, and under log of trimmed wood left lying on the ground, in Coimbatore and Mysore State.

Microtermes incertoides, Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 151 (1913?). Species described and recorded from Wallon, India; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 113-114 (April 1913). From Wallon, found together with *O. wallonensis*. Holmgren says that Wasmann regarded this species as identical with *M. incertus*. Species described.

Microtermes? incertus, Hagen, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 788-789 (July 1912). Distribution discussed and compared with *M. obesi*, *M. sindensis*, *M. tragardh* etc. Noted from Khandala, from galleries constructed in a nest of *O. obesus* form *b* and under stone.

Microtermes macronotus, Holmgren, Termitenstudien, iii, p. 43 (1912); Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'Recorded without description from Ceylon'; Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 145, pl. vi, f. 1, p. 145 (1913?). Species new, described from Ceylon.

Microtermes mycophagus, Desneaux, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 159-160 (August 1917). 'Destroying furniture in bungalow' from Punjab, Lyallpur, India.

Microtermes obesi, Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 150, pl. vi, f. 4 (1913?). Species new, described from Bombay; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 787-788 (July 1912). Species described and compared with *M. sindensis*. Noted from Khandala. Taken in nest of *Odontotermes obesus a*, Ramb.; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 159 (August 1917). At light from Mysore and Bihar; Fletcher, Bull. Dept. Agr. India, No. 100, p. 245 (1921). 'This termite is a serious pest of wheat seedlings at Pusa etc., and of wheat when coming into ear at Hosangabad. It also attacks cabbage and cauliflower at Pusa.'

Microcerotermes, Silvestri.

Microcerotermes annandalei, Silvestri, Rec. Ind. Mus., xxv, pp. 225-228 (1923). Fully described. 'A small number of specimens under bark of dead tree-trunk.' Barkuda, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Microcerotermes bugnioni, Holmgren, Escherich's Termitenleben auf Ceylon, p. 203 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 11 (June 1913). 'A minute species, found under logs of wood, in hollow stems of coconut palms etc., Ambalangoda; Maha Illuppallama (Anuradhapura District)'—Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, pp. 283-284 (January 1913). Imago described. Noted from Ambalangoda; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 390-391 (1926). Found in dead bark of coconut. Brief description given.

Microcerotermes cylindriceps, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 121 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 12 (June 1913). Holmgren (in Escherich's Termitenleben auf Ceylon, pp. 203-204) records this species from Galle 'in decayed pines of stem'.

Microcerotermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 170-171 (August 1917). 'Under dead log of sandalwood by path-

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side; red clayey soil; termites in galleries under mud along lower side of log. Very few soldiers.' From Mysore, Bababudin Hills, about 4,000 ft.

Microcerotermes greeni, Holmgren, Spolia Zeylanica, viii, pt. 32, p. 284 (1913); Green, Spolia Zeylanica, ix, pt. 33, p. 12 (June 1913). 'Distinguished by Dr. Holmgren, by the small size of the soldier'; Kemner, Bull. Ent. Res., xvi, pt. 4, p. 391 (1926). Very brief description given. In nest of dead tea. Ceylon.

Microcerotermes heimi, Wasmann. Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 789-792 (July 1912). Father Assmuth gives an exhaustive note on the nest. All taken from nests. From Borivli Jungle (Salsette Island). Holmgren has appended a note in which he discusses about the different types of nests in the case of those of *Eutermes* and *Microcerotermes;* Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 171 (August 1917). 'In galleries excavated in dead branches of a thorny bush. . .'. Mysore, Bababudin Hills about 4,200 ft., India.

Microcerotermes tenuignathus, Holmgren, Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 116-117 (April 1913). Species described. 'In dry food.' Vadtal in Guzerat, India.

Mirotermes, Wasmann.

Mirotermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 168-169 (August 1917). Species new described. From Bellary District. Humpi ruins about 1,200 ft. 'Found under stone'; also Bellary District, Hadagalli, 'in galleries in soil under a stone . . .'.

Sub-genus: *Mirotermes*, Wasmann.

Mirotermes (*Mirotermes*) *obtusus*, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 168 (August 1917). Bellary District, Hospet. 'Found in soil between surface and a depth of about one foot when digging up a nest of *Termes convulsionarius*.'

Hamitermes, Silvestri.

Sub-genus: *Synhamitermes*, Holmgren.

Hamitermes (*Synhamitermes*) *ceylonicus*, Holmgren, Stockholm. Vet. Ak. Handl., 50, No. 2, p. 225 (1913?). Species new described from Ceylon; Holmgren, Termitenstudien, iii, p. 91 (1912); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). This is at present a 'nomen nudum.' The name will probably replace *H. quadriceps* for the Ceylon species.

Hamitermes (*Synhamitermes*) *quadriceps*, Wasmann, Zool. Jahrb. xvii, pt. 1, p. 123 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). From 'under stones, Ambalangoda; Peradeniya' in Ceylon; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, p. 792 (July 1912). Holmgren creates a new sub-genus *Synhamitermes*. From Khandala, India. Assmuth records the tunnels constructed in the pillars of a nest of *O. obesus* form *c*.

Sub-genus: *Euhamitermes*, Holmgren.

Hamitermes (*Euhamitermes*) *indicus*, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 165-166 (August 1917). Species new described. From Shevaroy Hills, South India, from 'under a stone amongst dead leaves . . .'

Eurytermes, Wasmann.

Eurytermes assmuthi, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 124 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 12 (June 1913). 'Recorded from the collection of Dr. Escherich as "in association with *Termes obscuriceps;* and in earthen galleries under a stone, in the jungle." My own acquaintance with the species consists of the discovery of a small procession (containing winged adults and workers) travelling quite exposed—across a bare compound. They were emerging from one hole and entering another at a distance of about 5 yards'; Silvestri, Rec. Ind. Mus., xxv, p. 228 (1923). 'A number of nym-

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phae, workers and a soldier collected from a bank of earth among roots of *Hemigyrosa canescens* and a few specimens from small chambers at the roots of a fig tree.' Barkuda Island, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Eurytermes assmuthi, Wasm. var. *modestior*, Silvestri, Rec. Ind. Mus., xxv, pp. 228-229 (1923). Described. 'A small nest with very young queen and king, a number of workers and a soldier.' Barkuda, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Eurytermes ceylonicus, Holmgren, Stockholm Vet. Ak Handl., 50, No. 2, p. 222 (1913?). From Ceylon; Holmgren, Termitenstudien, iii, p. 83 (1912); Green, Spolia Zeylanica, ix, pt. 33, p. 12 (June 1913). 'Noted as a species, but without description. Bainbrigge Fletcher (in litt) suggests that, as Holmgren records *assmuthi* from Bombay only, it is probable that he has separated the Sinhalese species as distinct.'

Capritermes, Wasmann.

Capritermes ceylonicus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 204 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). 'Determined by Dr. Holmgren, from specimens collected by Dr. Escherich in nests of *Termes obscuriceps* at Peradeniya'—Ceylon.

Capritermes distinctus, Holmgren, Stockholm. Vet. Ak. Handl., 50, No. 2, p. 246 (1913?), pl. vi, f. 24, 30. Recorded from Ceylon.

Capritermes distortus, Silvestri, Rec. Ind. Mus., xxiv, pp. 541-543 (1922). Fully described. Noted from Kavalai (1,300-3,000 ft.), Cochin State.

Capritermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 169 (August 1917). Species described. From Malabar, Puthupadi Forest 'under a rotting bamboo'; from Anamalai Hills about 4,000 ft. 'Colony in a dead log'; from Mysore, Bababudin Hills, 4,400 ft. 'In galleries and chambers two to ten inches below soil at roots of coffee.'

Capritermes gravelyi, Silvestri, Rec. Ind. Mus., xxiv, pp. 535-537 (1922). Koyna valley, Satara District, 2,000-2,100 ft., Kas, Satara District, 3,700 ft.—India.

Capritermes hutsoni, Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 391-392 (1926). In roots of tea, from Ceylon. Species described.

Capritermes incola, Wasmann, Wien. Ent. Zeit., xii, pt. 7, p. 242 (1893); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). 'In nests of *Termes obscuriceps*, Peradeniya,' Ceylon; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, pp. 792-793 (July 1912). 'Termites in pillars of nest of *O. obesus* form *a*.' Also under stone. Recorded from Khandala, India; Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 170 (August 1917). From Nilgiri Hills, Ketti, 6,500 ft. in a potato field; from Coorg, Mercara, about 4,000 ft. in soil under sods and roots of grass; Mysore, Bababudin Hills, 4,600 ft. in galleries at roots of grass.

Capritermes longicornis, Wasmann, Zool. Jahrb., xvii, pt. 1, pp. 126-128 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). 'Dr. Holmgren doubts if this is specifically distinct from *incola*.'

Capritermes longirostris Wasm. var. *cornutella*, Silvestri, Rec. Ind. Mus., xxiv, pp. 537-538 (1922). Described from Randal Valley, Ratnagiri District.

Capritermes obtusus, Silvestri, Rec. Ind. Mus., xxv, pp. 229-231 (1923). Fully described. 'Few specimens under stone on damp soil at base of small fig tree.' Barkuda Island, Chilka Lake, South India; Annandale, Rec. Ind. Mus., xxv, pp. 233-251 (1923). Nesting and swarming habits given.

Capritermes obtusus Silv. var. *abbreviatus*, Silvestri, Rec. Ind. Mus., xxv, pp. 231-232 (1923). Barkuda Island, Chilka Lake, South India.

Capritermes punjabensis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 170 (August 1917). From Lyallpur, Punjab.

Capritermes speciosus, Haviland, Jl. Linn. Soc. London, xxvi, p. 413 (1898); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). 'Doubtfully from Trincomalle'.

Capritermes tetraphilous, Silvestri, Rec. Ind. Mus., xxiv, pp. 543-544 (1922). Fully described. From Rangamati, Chittagong, Bengal.

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Eutermes, Heer.

Eutermes biformis, Wasmann, Zool. Jahrb., xvii, pt. 1, p. 133 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 14 (June 1913). 'Possibly a variety of *rubidus*, Galle; Ambalangoda: both *rubidus* and *biformis* have soldiers of two sizes'; Holmgren, Jl. Bomb. Nat. Hist. Soc., xxi, No. 3, p. 793 (July 1912). Borivli Jungle, Salsette Island: in small galleries built on surface of bare ground; Khandala: most of these taken from under stone; Assmuth, Jl. Bomb. Nat. Hist. Soc., xxii, No. 2 (1913). Described as one of the wood-destroying white ants of the Bombay Presidency; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 162-163 (August 1917). Shevaroy Hills about 4,500 ft.—'Nest under stone, interior of galleries blackened; also Madras and Saidapet'; Hingston, Jl. Bomb. Nat. Hist. Soc., xxxii, pt. 4, pp. 717-725 (31st May 1928). The author gives a very interesting account of the insect from Central India; he also gives an account of the nest, foraging expeditions, duties of soldiers, special senses, and the insects compared with Hymenoptera.

Eutermes ceylonicus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 179 (1911). (?=*inania* var. *horni*, Wasmann); Green, Soplia Zeylanica, ix, pt. 33, p. 14 (June 1913). 'Nests in decayed wood. Constructs galleries of earthy or ligneous material, extending up the trunks of trees. A widely distributed species. Peradeniya, Kudugannawa, Ratnapura, Trincomalee, Passara, Diyatalawa'—Ceylon; Bugnion, Ann. Soc. Ent. Fr., lxxxiii, p. 361 (1914). Deals about the buccal pieces. Ceylon; Kemner, Bull. Ent. Res., xvi, pt. 4, pp. 388-389 (1926). Short description given. From galleries and bark of tea bush; reported ring-barking tea stem; dead wood of tea; and dead portion of dadap stem.

Eutermes ceyloniellus, Kemner, Bull. Ent. Res., xvi, pt. 4, p. 389 (1926). Ceylon: in stem and roots of tea.

Eutermes crassicornis, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 162 (August 1917). Anamalai Hills, 4,000 ft. in 'galleries in iron-wood'; Coorg, Sidapur, Margalli Estate, 3,500 ft. 'In gallery leading up tree trunk. The nest could be seen about 20 ft. up there'; Mysore, Bababudin Hills about 4,700 ft. 'in galleries over rotten logs and in these logs'.

Eutermes escherichi, Holmgren, Escherich's Termitenleben auf Ceylon, p. 199 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 15 (June 1913). 'Collected by Escherich in a nest of *Termes obscuriceps*, Peradeniya'—Ceylon; Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 107-109 (October 1913). Notes on the species given.

Eutermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 161-162 (August 1917). Species described. Shevaroy Hills, 4,000 ft. 'Running black galleries over a rock in the cracks of which were found large numbers of soldiers, workers, nymphs and young.' Also in 'galleries over dead tree-stump and in chambers excavated in mud and bark of same.'

Eutermes hantanae, Holmgren, Escherich's Termitenleben auf Ceylon, p. 198 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 14 (June 1913). 'A rare species; recorded from Hantana range only'—Ceylon; Bugnion, Spolia Zeylanica, ix, pt. 35, pp. 155-162 (March 1914). Described and compared with other species of the genus; Bugnion, Ann. Soc. Ent. Fr., lxxxiii, p. 362 (1914). Deals about the buccal pieces.

Eutermes heimi, Wasmann, Zool. Jahrb., xvii, p. 135 (1902). From India; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 163 (August 1917). Coimbatore—'abundant here coming out towards sunset and foraging little bits of dead grass etc., and sometimes biting off pieces of green grass and carrying them into the nest. The individuals have a very characteristic aromatic odour'; Madras—'At light'; Bellary District—'Under a stone in Humpi ruins'; Mysore State, Maddur—'in the ground at roots of a tree alongside a colony of *Camponotus*'.

Eutermes inanis, Haviland, Jl. Linn. Soc. London, xxvi, p. 425 (1898); Green, Spolia Zeylanica, ix, pt. 33, p. 14 (1913). 'Recorded by Dr. Bugnion from Ambalangoda'—Ceylon.

Eutermes indicola, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, p. 161 (August 1917). From Coorg and Anamalai Hills. 'From nests in live trees and in dead stump.' Species described.

Eutermes kotuae, Bugnion, Ann. Soc. Ent. Fr., lxxxiii, pp. 351-359 (1914).

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Deals about the buccal pieces, Ceylon; Bugnion, Ann. Soc. entom. suisse., xii, pp. 192-200 (1914)—Ceylon.

Eutermes lacustris, Bugnion, Compt. Rend. Sci. Soc. Biol. (Fr.), lxxii, p. 1091 (1912); Green, Spolia Zeylanica, ix, pt 33, p. 15 (June 1913). 'In stems of "Kaju-nut" (*Anacardium*), *Hevea, Elaeocarpus*. Ambalangoda, Kalutara. Distinguished from all the other local species of *Eutermes* by the dark brown heads of the soldiers'; Bugnion, Rev. suisse de Zool., xx, pp. 487-505 (1912)—Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, pp. 282-283 (January 1913). Green has added a footnote wherein he states that Dr. Holmgren originally described this species as a new species *E. greeni*, but Dr. Bugnion has already published this as *E. lacustris* thereby taking precedence. Soldier and worker described; Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 110-112 (October 1913). (=*E. greeni*, Holmgren, 1912.) Notes on the species given; Bugnion, Spolia Zeylanica, ix, pt. 35, pp. 149-154 (March 1914). The imago described.

Eutermes longicornis, Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 172, pl. vii, f. 5 (1913?). Species new from Ceylon; Holmgren, Spolia Zeylanica, viii, pt. 32, p. 283 (1913); Green, Spolia Zeylanica, ix, pt. 33, p. 15 (June 1913). 'On stems of "Giant Bamboo" (*Dendrocalamus giganteus*) and also in a nest of *Termes obscuriceps* Peradeniya'—Ceylon; Bugnion, Ann. Soc. Ent. Fr., lxxxiii, pp. 361-362 (1914). On the buccal pieces—Ceylon.

Eutermes monoceros, Koenig, Schrift Berl. Nat., iv, 17, p. 25 (1779); Green, Spolia Zeylanica, ix, pt. 33, p. 14 (June 1913). 'The common black termite of Ceylon. It constructs its nests in hollow stems and branches of trees, guarding the entrances by pendent masses of black material composed of the excreta of the insects. Long processions of the termites, sometimes extending several hundred yards, may often be seen crossing the roads. Found throughout the island, upto about 2,000 ft.'—Ceylon; Bugnion, Ann. Soc. Ent. Fr., pp. 271-281 (1909); Bugnion, Bull. Soc., v and Sc. Nat., xlvii, pp. 417-437 (1911); Bugnion, Bull. Soc. ent. suisse, xii, f. 4, pp. 119-123 (1912); Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 112-116 (October 1913). Notes on the habits of the species given; Petch, Ann. Royal Bot. Gardens (November 1913); Bugnion, Ann. Soc. Ent. Fr., lxxxiii, pp. 359-360 (1914). Gives an account of the buccal pieces—Ceylon.

Eutermes oculatus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 200 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 15 (June 1913). 'Described from winged adults only, Peradeniya. Probably the winged stage of *E. escherichi*'; Oscar John, Spolia Zeylanica, ix, pt. 34, p. 109 (October 1913). (=*Eutermes longicornis*, Holmgren, 1912). Notes on the species.

Eutermes preparvus, Holmgren, Escherich's Termitenleben auf Ceylon, p. 201 (1911); Green, Spolia Zeylanica, ix, pt. 33, p. 15 (June 1913). 'Also described from winged adults only, collected by Dr. Uzel at Peradeniya and Henaratgoda'—Ceylon.

Sub-genus: *Grallatotermes*, Holmgren.

Eutermes (*Grallatotermes*) *grallatoriformis*, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 163-164 (August 1917). Anamalai Hills, Tellkadi, 'under long galleries on mango stem'; in South Kanara, Aryapur. Holmgren is of opinion that the species is noteworthy in that it reminds one strongly of *Eutermes grallator*, from New Guinea.

Sub-genus: *Subulitermes*, Holmgren.

Eutermes (*Subulitermes*) *inaniformis*, Holmgren, Stockholm Vet. Ak. Handl., 50, No. 2, p. 154, pl. vii, f. 1 (1913?). Species new. Hinterindien.

Sub-genus: *Trinervitermes*, Holmgren.

Eutermes (*Trinervitermes*) *rubidus*, Hagen, Linn. Ent., xiv, p. 117 (1860); Green, Spolia Zeylanica, ix, pt. 33, p. 14 (June 1913). 'A widely distributed species. Found under stones, and forming small piles of fine earth on the surface of the soil. Peradeniya, Anuradhapura, Ambalangoda, Diyatalawa'; Holmgren, Escherich's Termitenleben auf Ceylon, pp. 133-134 (1910). Observations on the species; Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 104-107 (October 1913). Noes on the species; Bugnion, Ann. Soc. Ent. Fr., lxxxiii, p. 362

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(1914). Deals with the buccal pieces, Ceylon; Kemner, Bull. Ent. Res., xvi, pp. 389-390 (1926). Description brief. Grass lawn. Ceylon.

Anoplotermes, Fr. Muller.

Sub-genus: *Speculitermes*, Wasmann.

Anoplotermes (*Speculitermes*) *cyclops*, Wasmann, Zool. Jahrb. xvii, pt. 1, p. 161 (1902); Green, Spolia Zeylanica, ix, pt. 33, p. 13 (June 1913). 'Under logs of wood, Peradeniya, Maha Illuppallama,' Ceylon. *Anoplotermes* is distinguished by the absence of the soldier caste. The workers might readily be mistaken for those of *Eutermes*, of which Dr. Holmgren considers this genus to be an offshoot; Oscar John, Spolia Zeylanica, ix, pt. 34, pp. 103-104 (October 1913). Notes on the species given; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 164-165 (August 1917). Shevaroy Hills, 'under stone'; Bellary District, 'from galleries in earth' and 'under dead *agave* stumps lying on the ground'; Coorg, 'in soil, said to damage coffee roots, but this is doubtful'; Mysore, Bababudin Hills, 'in galleries and chambers in the ground . . .'

Termopsis, Heer.

Termopsis wroughtoni, Desneaux, Jl. Bomb. Nat. Hist. Soc., xv, pt. 3, pp. 445-446 (1904). Kashmir, species new, described; Desneaux, Jl. Bomb. Nat. Hist. Soc., xvii, pp. 293-298 (1906). (=*Termopsis Radcliffe*: Indian Forester, p. 412. Gives an account of the genus.) In old stumps of *Pinus excelsa*.

Eremotermes, Silvestri.

Eremotermes fletcheri, Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 167-168 (August 1917). Species described. Coimbatore, 'issuing from holes in ground at 0-30 p.m. during sunshine'.

Eremotermes paradoxalis, Holmgren (=*Pseudomirotermes*, Holmgren) Stockholm Vet. Ak. Handl., 50, No. 2, p. 232 (1913?). Vorderindien. Species new; Jl. Bomb. Nat. Hist. Soc., xxii, No. 1, pp. 115-116 (April 1913). Bangalore, 'in remarkably flat tunnels (transverse section oblong-ovate) constructed in pillars of mound of *O. bangalorensis*.' Holmgren thinks that it will be interesting to know whether this genus—like *Mirotermes*—contains forms jumping by the aid of their mandibles; in this case the parallelism with *Mirotermes* would be nearly complete. Species new; Holmgren, Mem. Dept. Agr. India, Ent. Ser. v, No. 3, pp. 166-167 (August 1917). Coimbatore, 'emerging from small holes in the ground after a shower of rain, at about 4 p.m. . . .'; Central Provinces, 'on outskirts of mound-nest . . .'; Bihar, 'on wing, 5-30 to 6-30 p.m. over grass lawn'.

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REVIEWS.

THE NIDIFICATION OF THE BIRDS OF THE INDIAN EMPIRE. By E. C. Stuart Baker, C.I.E., O.B.E., F.Z.S., etc. Volume III. PLOCEIDAE-ASIONIDAE. (Taylor and Francis, 30/-.)

The present volume completes the account of the nidification of the Passeres, the families dealt with being the Weavers, Finches and Buntings, Swallows and Martins, Wagtails and Pipits, Larks, White-Eyes, Ruby Cheek, Sunbirds, Flowerpeckers, Pittas and Broadbills.

It continues with the Non-Passerine or Pico-Passerine birds, including the Woodpeckers and Wryneck, Barbets, Cuckoos, Parrots, Rollers, Bee-eaters, Kingfishers, Hornbills, Hoopoes, Trogons, Swifts, Nightjars, and concludes with the Owls.

In a review of Mr. Stuart Baker's second volume of this work which appeared in a contemporary, exception was taken to the classification, which the writer held to be inaccurate, and it therefore seems to us essential that we should also refer to this point.

The volumes on Nidification are written on the same lines as the Bird volumes of the Fauna of British India by the same author, and it stands to reason that the same classification is adopted in both works.

So far from being inaccurate, this work is, in the words of an American review, 'the last word in patient and exhaustive research, bringing nomenclature up to date, and laying a wonderful foundation for further detailed research'. The author has, moreover, himself carried the nomenclature in the present work to a still further degree of accuracy, and has included all the corrections rendered necessary by his own discoveries and by those of other ornithologists since the dates on which the Fauna appeared.

Yet another point to which we would allude is the alteration in so many of the trivial names, which have been made in the interests of future, and not of past, ornithologists and students. As the author himself remarks, to call a bird by a man's name, e.g. 'Baker's Sparrow' or 'Jones' Titmouse' conveys nothing to the mind of the student, whereas such names as 'The Punjab House Sparrow' or 'The Ceylon Black-headed Titmouse' to give a couple of imaginary names, would at once convey an idea both of description and locality.

Field naturalists have long deplored the use of these meaningless complimentary names in trivial nomenclature, and we congratulate the author on his break with tradition in the interests of common sense.

These being our views on the above points, it is almost needless to add that in the present work Mr. Stuart Baker fully maintains the high standard which he set himself in the previous volumes. We have learnt to anticipate this from past experience of his writings and expectations are more than realised. In fact, we will go so far as to say that this book surpasses in interest even the two preceding, dealing as it does with some of the most extraordinary and varied nesting habits that it is possible to conceive.

As in the earlier volumes, the serial number given corresponds with that in the Avifauna, and of the total of 704 species and subspecies included in that work, the nidification of 545 species and subspecies is now recorded. Of the remainder, 61 breed outside the area of the present work, whilst nothing is so far known of the breeding habits of the remaining 92.

It is possible that some disappointment will be felt that limitations of space have precluded the author from telling us more about the parasitic Cuckoos, a subject upon which he is undoubtedly the greatest living authority.

Consolation however is forthcoming in his promise to devote a separate work exclusively to this fascinating subject, and in this book all that is known will be exhaustively dealt with and the various theories, with the evidence for and against them, fully discussed. This work, when it appears, should be of the most absorbing interest, and will be eagerly awaited.

Returning to the book under review, the description of the nests and lovely eggs of the Rose Finches makes most fascinating reading, and there are very full accounts of that curious species the Forest Wagtail, of the

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exquisite nests of the Spider Hunters, of the Sunbirds, and of the tiny Flower-peckers.

Of different, but equal interest are what may, for want of a better term, be called the curiosities of bird architecture. Among these we would draw attention to the (apparently unnecessarily) huge structures of some of the Broadbills, and going to the other extreme, the tiny felted pads of the Frogmouths, birds of considerable size; and to the penchant of certain Wood-peckers and Kingfishers for ants' nests in which to lay their eggs, and to the immunity of these from destruction by the ants.

To these may be added the well known immuring of female Hornbills during incubation and often for some time after the eggs are hatched; the nesting habits of the Spinetails, which for so long defied all the efforts of field workers; the Swiftlets, famed as the producers of edible nests, and the well nigh invisible saucer of the Crested Swifts, barely large enough to contain the single egg.

It is safe to say that from the first page to the last the book is a mine of information, much of which is new, and all of which is set out in the eminently readable style, coupled with scrupulous accuracy, which one has come to associate with everything that emanates from Mr. Stuart Baker's pen.

We have only been able to detect one error, and this doubtless occurred in copying the manuscript note accompanying the eggs. We refer to the description of the nesting of the Javan Small House Swallow on the cliffs in Arakan, where the nests were only 18 *inches* and not 18 *feet* from the top. This accounts, of course, for the remark that the nests were easily accessible from above, as the finder informs us that he had merely to walk along the top from the land side to reach the nests, though these would have been quite inaccessible from the sea below.

The book contains eight beautiful photographs, the work of Col. Rattray and Capt. Bates, with a frontispiece by the author, and once again the printing leaves nothing to be desired.

Volume iv, which will be the last, is nearing completion, and will include the Accipitrine birds, Game birds and Waterfowl.

C. H.

HUNTERS' MOON. By Major LEONARD M. H. HANDLEY, M.C., pp. 267, price 15/. (Macmillan & Co., Ltd., London.)

There surely should be some limit to the inaccuracies which find their way into modern books which purport to set forth observations of interest to Natural Scientists and Shikaris.

A recent book *Hunters' Moon*, by Leonard Handley, is so open to criticism in this respect that one is led to the conclusion that the author has depended on his imagination and trusted to the credulity of the public, for purposes of producing a 'best seller' rather than a work of sporting or scientific value.

The following observations in this book are I consider inaccurate:—

(1) The author's trackers having tied a full grown sambhur stag to a jungle branch shouldered and carried it off. To anyone knowing the size and weight of a full grown sambhur stag this feat would seem to be an impossible one.

(2) A part of the C. P. jungles is described as being unknown and unowned. This information should be of interest to the Government of India and to the Forest Department of the C. P.

(3) The author describes the Sladang as *Malay buffalo*!

(4) The author sees 'two luminous eyes' of what he takes to be a snake watching him from the 'depths of a tree trunk' at night.

(5) An elephant, mortally wounded in its spine, managed to cross a river and dies in the effort!

(6) The author speaks of trying to eat the 'perfectly formed foetus' of an Octopus, although an Octopus is oviparous. If the author did eat one at all it must have either been a very young specimen or an embryo from an egg.

(7) The author apparently had a good moon for the whole period of two months he was in the Tenasserim jungles.

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(8) He is not accurate in his dates. He starts off after a man-eater in February and on the 9th January he arrives at his destination!

(9) In his descriptions of the man-eater's victims the left leg in each case is said to have been devoured. The photo of one of the victims shows the left leg intact!

(10) The author arrives in the evening at a Gond village. Later he and four of the villagers ('tired out with the gathering of the day's crop') sleep round a fire. The man-eater seizes one of the villagers and a photo is shown of the victim holding the author's rifle and described as his 'favourite Gond', regardless of the fact that the author had not met him before, and no photograph could have been taken when the author and his two Gonds from another village arrived late and tired.

(11) The author writes that no animal could recover almost instantaneously from a solid .470 bore bullet and get clean away: quite a mistaken idea. Elephants and the larger game animals frequently do so, if hit in a non-vital spot, just as a bison shot by the author with his .470 bore rifle nearly gets away.

(12) The old fallacy about the necessity of allowing a leech to drink to satiation, otherwise if pulled off 'a portion of the epidermis is removed' is repeated by the author.

(13) The author should make it clear that his Tanoy (the Siamese poacher) has no connection with the well-known Tracker (and poacher) of the same name of those parts—who is still alive and active.

(14) Besides moths, flying ants, tree spiders, mosquitoes and horned beetles are apparently included in the '*flying lepidoptera* of the Ceylon jungles'.

(15) It is not understood why the hills of Ranga are persistently termed 'Blue Hills' when it is admitted that their Canarese name indicates 'white hills'. The Nilgiris, an adjoining range, are the Blue Hills.

(16) Blue Gums are incorrectly described as growing in Mysore City.

(17) The western boundary of a shooting Block is described as being 'lost in Mysorean infinity'. In actual fact another shooting Block intervenes between this and the Mysore territory.

(18) The big game on the Billigirirangans in South India is described as migrating to the small jungle clad sholas during the monsoon to avoid the 'torture of leeches'. Actually during the monsoon most of the big game animals leave the sholas (evergreen jungle) which are then infested with swarms of leeches.

(19) Quite incorrectly 'Mulay Kadu' is described as meaning 'great rain forest'. It is nothing of the kind. Mullay Kadu means 'hill forest' (*Canarese*: Malay—hills; kadu—forest) and the deciduous jungle alone is termed thus by the local Sholagas. The author errs in this with better company, as the late G. P. Sanderson in his *Thirteen Years among the Wild Beasts of India* makes the same mistake, and this error is presumably copied by the author as he quotes from Sanderson's book on another page.

(20) The bite of green Grass Adders is described as being fatal. This is hardly correct, as only small children, or a person in a very weak state of health, would be likely to die from the effects of the bite of one of these snakes, nor is it understood how the author came across so many of these species during the S.-W. monsoon.

(21) A honey bird is described as leading the author and his trackers to its hive, an old and incorrect fairy tale. A honey bird is so called I believe on account of its habit of feeding on the nectar in the flowers.

(22) A saddle is incorrectly described as meaning 'Elephant crossing': actually the name means 'Mara's (man's name) Saddle'.

(23) 'F' of Bedaguli is described as having been killed in the war and buried 'betwixt the Tigris and the Euphrates'. Actually 'F' died from pernicious anaemia and was buried in Kent some years after the war.

(24) The author's sadness is described at seeing relics of 'F's' huts etc. in the jungle. 'F' was still alive at the time of the author's tale and moreover used those very huts later.

(25) All sportsmen will condemn the author's advice that a snapshot should be taken at a bull bison if no clear shot is obtainable. Many a wounded bull has been lost, and a cow shot in mistake for a bull, by shikaris adopting these tactics, and this type of advice cannot be too strongly deprecated.

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(26) The author speaks of the great forest of 'Sal' on the Billigirirangans. There is no sal growing on the Billigirirangans, nor, I think I am correct in saying, anywhere in South India.

(27) 'Shaking with excitement I throw all precautions to the wind and aim into the brown of the great shadow ahead'! The unfortunate 'great shadow ahead' is a bison which the author very luckily managed to bag.

(28) The bison is described as making for 'the wall of the great Mulay Kadu', and it is indicated that the bison would have been lost had it reached its objective. The Mulay Kadu is the natural habitat of bison, open deciduous jungle where most bison are tracked and shot.

(29) Jackals are described as being near the author's camp on the Billigirirangans. There are however no jackals on these hills.

(30) Dodsampagai block is described as stretching west from a certain spot. Actually this shooting Block lies north from the locality indicated, Coimbatore lying to the South.

(31) A rough palisade of jungle bamboo, described as having been placed by the author round his camp to give warning of the approach of elephants and shown in the photo of his hut on page 260 was not erected by the author but by a Planter on the Billigirirangans. The fence was erected to keep out cattle. The photo is of the Planter's camp which he was permitted the use of.

(32) The story of the elephant cow 'galloping off', on the author's approach, after giving birth to a still born calf sounds incredible. A cow elephant with a newly born calf (alive or dead) is an exceedingly dangerous and aggressive animal.

(33) It is not explained how the author's Sholaga tracker blew off the Russel Viper's head with the rifle the author was carrying. If it is meant that the tracker accomplished this with a second gun, the author must have been as near to death from the tracker's feat as from the Viper, unused as are Sholagas to modern weapons.

(34) The tale of the Hyaena and the wild dog pack sharing the same meal is incredible. I doubt if any authentic case has been known of wild dogs tolerating the close proximity of another animal while feeding?

(35) The District Forest Office unfortunately shows no record of 12 wild dogs and a tiger having been shot by the author at the time described. A tiger, and about this number of wild dogs, *were* however shot by another sportsman in the same Block that year.

(36) The story on page 253 of the author climbing down from his machan, leaving his rifle (surely a very foolish act), to investigate a noise is remarkable. He describes a bamboo jungle as being inky black (although there was a 'full moon in a cloudless sky') and yet he manages to see a black sloth bear. Returning the author sees 'in the distance' a great carnivorous beast approaching along a fire line which he had to cross. It is not explained how the animal did not see him, but it passed so close that 'he could have touched every spot on his sleek body'.

(37) The reference to a bamboo receptacle as a requirement on a machan for certain purposes is crude and vulgar. Most normal sportsmen find no necessity for this.

(38) The stories of the elephant removing the author's machan ladder, the tin of Army Rations bursting in his tracker's face, and the visit of an elephant to his Hulpatchayhulla camp (which the author was invited to) are a remarkable series of coincidences as these were also the experiences of a Planter on the Billigirirangans and were related to the author.

There is no record in the Office of the Deputy Commissioner, Mandla, nor in the Mandla Division (including the Danauli Reserve) Forest Office, of the author having destroyed the Danauli man-eater, which is said to have been killed later by a Mrs. Haygate. The author shot in the Bajag Block in February 1925, to my knowledge, and the man-eater was destroyed in 1926 in the same area.

In conclusion I consider the author's 'Apologia' at the end of his book as inadequate and misleading.

R. C. M.

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MISCELLANEOUS NOTES.

I.—A TAILLESS TIGER.

(With a photo).

Early in the morning of the 1st instant I shot a very large tailless tiger. On examination I was interested to find that there was merely a blob of flesh ending up with loose skin, much the same as goats have, and that there was no sign of gristle or hard root that would indicate that the tiger had had a normal tail previously.

The tiger measured 6¾ ft. between pegs and would have measured quite 10 ft. had it possessed a normal tail judging from the length of the tail of a 10 ft. tiger I shot in 1931.

I enclose a photo of the tiger and a close-up of its 'goaty' tail.

HONNAMETTI ESTATE,
ATTIKAN P.O., *Via* MYSORE,
S. INDIA.
May 26, 1934.

R. C. MORRIS, F.Z.S.

II.—'RATELS AND CORPSES'.

Mr. Champion in his book *The Jungle in Sunlight and Shadow* writes thus: "This accusation of *eating* corpses is a libel which is widely brought against this animal by people who do not know what a Ratel is. So far as I am aware no reputable naturalist

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has ever obtained first-hand evidence of such an act on the part of these creatures which are so omnivorous that they can have little difficulty in obtaining ample food of other kinds. True it is Dunbar Brander states in his book that he once gave evidence in a murder case of *this* habit of the Ratel; but if I had been the Judge, I am afraid that I should have questioned his evidence very closely indeed, for *it was almost certainly based on Indian superstition*, which by no means always follows facts.'

What I wrote in *Wild Animals in Central India* was as follows:

'They also eat carrion and one of their names "The Grave-Digger" is thoroughly earned as I have known them *exhume* a corpse. I once had to give evidence regarding this habit in a murder trial, the defence relying on the exposed human remains being those of a corpse removed from an adjoining grave.'

In view of the fact that Mr. Champion has freely quoted from *Wild Animals in Central India* as well as obviously finding its textual content very useful, it is lamentable that he should not have referred to me before publishing the rash and incorrect statement to which he has committed himself.

Had the name 'Grave Digger' rested merely on Indian superstition, this would have been stated. From the context of what I wrote, it is obvious, that it rested on no such insecure foundation. 'Other Jungle Animals' are treated in the concluding chapter of *Wild Animals in Central India*, and this chapter commences by definitely stating, that the difficulty arose as to what to say, and what to omit. As a matter of fact to have said all, would have entailed at least another, and companionate volume, to the one published.

It is now necessary to satisfy Mr. Champion's unfulfilled desires to cross-examine me. Before doing so, however, it is pertinent to enter an objection to the self-appointed 'Judge'—as he confuses 'eating' *his* word, in *his* book, with the word 'exhume'—*my* word, in *my* book. It is a point worth mentioning, although not one to which I attach great importance, as I certainly will not acquit the Ratel of possibly eating from a corpse. The point is on the judge not the Ratel. Mr. Champion in his book refers to the Ratel having been known to eat the flesh of a dead animal: whether fresh or decayed is not stated, but from the human point of view, probably the latter. I have known them eat decayed buffalo and from the Ratel's point of view I see no reason why it should reject decayed humanity. Perhaps Mr. Champion will tell us why it should, and according to him does? The significance of my use of the word 'exhume' now becomes apparent. I have no direct evidence of 'eating' corpses, and in writing of animals of Central India I endeavoured to be as accurate as I could, especially so with regard to fact. I tried to avoid one step beyond which evidence would carry me. Whether the Ratel merely 'exhumes' the corpse for what he hopes to find associated with it, or for the purpose of eating it, I cannot say. My belief is both: but from Mr. Champion's own quotation about Ratel's unearthing dung in search of grubs, ample motive for unearthing a corpse can be inferred. Incidentally I take this opportunity to

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mention that it is due to dung dropping that one so frequently finds bears' excavations on paths and jungle roads.

Now for some evidence. During the rains, when one is more or less confined to headquarters, there was a colony of Ratels about 2 miles distant from my house on the bank of a considerable nala: lower down on the banks of the same nala, there was a native cemetery. The Ratels came under my frequent observation. One of their favourite excavating grounds was the cemetery and human remains were frequently exposed. Perhaps Mr. Champion will tell us where he has observed Ratels in the vicinity of a cemetery? and where they did *not* burrow in it? Ratels living in jungles like North Kheri have no opportunity of exhuming corpses. Duty once compelled me to spend a few days in camp in one of these miserable way-side stations on the main line near Harda. As usual there was no regular camping ground. My tents were pitched on the bank of a wretched nala. During the first night, infuriated dogs showed that some animal was prowling round. Daylight disclosed a large hole dug about 30 yards from the tent-door which exposed putrid human remains: part of the corpse was found some 30 yards further off in the bottom of the nala. The desecrater was a Ratel. Enquiry disclosed that some 2 months previously a very sick Mohammedan had descended from the train and was found dead next day on the platform. Whence he came, and who he was had not been discovered, so he was 'planted' on the bank of the nala, whence the Ratel subsequently excavated him. There is some of the evidence which can account for human remains being exposed by the Ratel, and I may add by asking how rarely the occurrence can come under interested, and intelligent observation?

It is a matter of some surprise to me that according to Mr. Champion local people in the United Provinces are unaware of the Ratel's existence as evidences of its presence were abundant. In the Central Provinces although Ratels dwell 'out', they nearly always have a base, usually an earth, sometimes hollow trees, rocks or a fallen bamboo clump. Animals which live in burrows usually require freedom from flooding and good drainage. Much of the North Kheri division, to which Mr. Champion refers more particularly, does not lend itself to burrows; possibly, in consequence, these are dispensed with.

There is no mystery about the Ratel's climbing abilities. Two Ratels used to inhabit the patch of jungle below the Telekeri Tank, at Nagpur, ¼ mile from the club. Any one interested may possibly still see their claw marks, just like a miniature bear's, on some of the trees: especially the end trees where the jungle narrows a to V before petering out. I used to surmise that they went up these trees to have a 'look-see' before entering the station.

It is impossible to say if the peculiar colouring of the Ratel has been specially developed for protective purposes. That it is protective it is hard to deny, especially in the face of the beautiful photograph published by Mr. Champion opposite page 56, and one would imagine more protective in moonlight than otherwise—especially to an animal which habitually quests in bare ground. The

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argument that the moon does not function continuously has only a very modified implication—protective colouring in animals does not necessarily operate under all conditions, all the time. It may develop to meet a particular hazard. It is gratifying to find corroboration of the Ratel's courage, as so far as I know I was the first person to draw attention to this attribute of the gallant little beast.

Ivy Bank, Elgin, N.B.,
Scotland. A. A. DUNBAR BRANDER.
June 24, 1934.

III.—DEATH OF AN ELEPHANT (*ELEPHAS MAXIMUS* LINN.) WHILE CALFING.

On the 30th of last month my wife and I came on a cow-elephant that had just died while giving birth to a calf, a case of breech presentation. The elephant had apparently been lying there in great pain and had actually been shifted a few yards by other members of the herd in their attempts to help her up. An examination of the elephant showed that the breech and hind legs of the calf were born. While we were there another elephant came up within a few yards of us very silently. A day or two later I shot a wild dog feeding on the dead elephant's trunk. Some days after I observed that 5 King-Vultures were in full possession of the carcase while hundreds of their common kindred were perched on the surrounding trees. The herd remained in the vicinity for 3 or 4 days and were, from the volume of trumpeting and other vocal efforts, apparently disturbed over the whole affair.

I understand that a cow-elephant died under very similar circumstances on the borders of Pampadampara Cardamom Estate on the Cardamom Hills in Travancore last month.

The half-born dead calf was removed from its dead mother, under instructions from the local Forest subordinates I was informed. This is interesting in view of the prevailing Hindu custom in South India of extracting the dead body of a child from the corpse of a pregnant woman.

Honnametti Estate,
Attikan P.O., *Via* Mysore,
S. India. R. C. MORRIS, F.Z.S.
April 25, 1934.

IV.—DEATH OF 14 ELEPHANTS (*ELEPHAS MAXIMUS* LINN.) BY FOOD POISONING.

I am indebted to Mr. A. Wimbush, the Chief Conservator of Forests, Madras, for the following information connected with the death of 14 elephants from eating Kodo millet known locally as 'Varagu'.

On the morning of 17th December, 1933, the villagers in the fields adjoining the Vannathiparai Reserve Forest came upon 11

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elephants lying in the patta fields and 3 in the adjoining Reserve. By 3 p.m. in the afternoon the elephants in the fields were dead while the 3 in the Reserved Forest were obviously in a very bad condition and died later. The Veterinary Surgeon of Periyakulam conducted a post-mortem on two of the elephants and the viscera were sent to the Chemical Examiner.

Ripe 'Varagu' occasionally gets into a poisonous condition though its appearance then is no indication of this and the knowledge that the grain is fit for consumption is said to be gained by either cooking and tasting a very small quantity or observing the condition of the cattle during the threshing season. The antidote for the poison is said to be tamarind-water or buttermilk in large quantities.

Results of the chemical examination showed that the elephants had died from Kodo millet poisoning. It is reported that a similar case of elephants being poisoned by 'Varagu' occurred some years previously in a field in the same area. When this grain is in a poisonous condition it is apparently known as 'Kiruku Varagu'.

In the case of the 3 elephants that were found in the Reserve Forest the Range Forest Officer reported that water and tamarind fruit were supplied to them by the villagers and by this means the life of one of them was saved, but this is not confirmed.

HONNAMETTI ESTATE,
ATTIKAN P.O., *Via* MYSORE, R. C. MORRIS, F.Z.S.
S. INDIA.

May 22, 1934.

[The poisonous millet referred to by Mr. Morris as 'Varagu' is undoubtedly the millet known as *Kodra* or scientifically as *Paspalum scrobiculatum* Linn. The species is well known for its occasional poisonous properties and effects on man and beast. Dr. Mann writes: 'The grain as well as the straw of Kodra frequently, if not always, contains a poisonous narcotic principle which causes vomiting and vertigo. For this reason care is taken at least in the Konkan to prevent cattle straying into Kodra fields. The poisonous principle is probably produced under unfavourable conditions of climate and season and the grain and straw are only poisonous in particular seasons. It is said that . . . the narcotic property is to some extent neutralised by steeping in cowdung and water, or by keeping the grain for a number of years. Though the poisonous and non-poisonous grain cannot usually be distinguished by ordinary people, yet cultivators in Gujarat claim that the diseased grain can be detected while threshing as then the effects of the poisonous dust is felt both by the threshing bullocks and their driver.'

According to Dr. Lisboa the symptoms of poisoning resemble those caused by Datura and are severer in cattle than in man, due no doubt to the eating of the grain and husk and also to the absence of vomiting.—EDS.].

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V.—SOCIAL BEHAVIOUR OF BISON (*BIBOS GAURUS* H. SMITH).

I was lucky enough last Sunday to be able to spend a considerable time watching the interesting behaviour of a herd of bison in their breeding season.

The Grass Hills above the Anamallai District run up to about 8,000 ft. and adjoin the Kanan Devan Hills of Travancore. They are very similar country to both these Hills and the Nilgiri downs. There is a considerable variation in altitude in our Grass Hills but the bulk of them are rolling grass land split up by streams and large and small sholahs.

At about half past eleven we were sitting on a ridge having a snack when we spotted a herd of bison about 1000 ft. below us grazing in the open between two sholahs. Through the glasses there was obviously nothing very big amongst them but a few minutes later two large bulls appeared on the edge of a sholah about a quarter of a mile behind the herd. One of them was doing a great deal of dancing about and demonstrating at the other and from subsequent examination of the ground they must have been scrapping out of sight of us for some time. The demonstrator was strangely enough the loser as presently he trecked off by himself and lay down on a small hill top right in the open a good distance away from any sholah whilst his opponent grazed his way towards the herd and joined them.

We watched the loser for some time but he made no attempt to move and looked so dejected that I came to the conclusion that he must have been badly damaged. My companion had never seen a bison before so we decided to go and have a look at him. It took us some time to get down to him and by the time we got there we could find no sign of him. Probably he winded us as this stretch of country is a mass of small round topped hillocks and the wind was all over the place as there were several thunderstorms going on down below us.

We then went on to have a look at the herd which had not shifted, and were moving about between two small sholahs and a patch of grass. This is unusual in this type of country in the middle of the day, as bison generally prefer to lie up in sholah, but the thunder may have made them restless, or possibly their restlessness was due to the fact that several of the cows were on heat.

We got well in and sat down to wait as it was impossible to move any further the intervening ground being absolutely bare with no dead ground.

The only members of the herd which remained permanently in the open were some six or seven calves of 2 or 3 months old. These calves were in the charge of a young bull who lay with them and moved with them whenever they moved. Incidentally the calves all lay together in a bunch and never attempted to straggle. Presently a young cow came out of the sholah and one of the calves got up and rushed at her for a drink. After being suckled for a few minutes it rejoined the others and the cow started to graze. A young bull not quite in his prime promptly

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tried to mount her but she would not stand to him. A few minutes later out came the victor of the morning's battle, a fine old jet black bull with very worn horns but a small head of not more than 35 in. He did not attempt to chastise the impertinent youngster who moved off well out of his way. There were at least four young bulls in the herd, in their prime but not as dark as he, and although they kept out of his way they appeared to graze quite happily with the herd.

In the course of the next quarter of an hour the master bull tried to mount two cows who were evidently not quite in season, and spent a good deal of time talking to himself and the world in general. This mating noise made by bull bison is best described as being very similar to that made by a domestic bull in a loose box when he hears the cows being driven out past his box door, only it is not so loud. It is delivered in much the same way as with a domestic bull with the head stretched out and slightly up, and the mouth just open. I have heard it used by a bull which had lain up some distance behind a herd and was hurrying to catch them up when they had grazed on in the evening. This was not in the mating season, so that perhaps it is wrong to call it a mating noise. It is quite distinct from the shrill bellow sometimes used by bull bison and which may easily be mistaken for an elephant's trumpet.

Now several interesting points arise out of this observation.

Bison in these hills drop their calves from about the beginning of March until the end of May which seems on the face of it an odd proceeding when the young calves, a few months old, have to face a very severe S.-W. Monsoon which has been known even in this district, two thousand feet lower, to register 80 in. of rain in a month. Occasional calves are born at other times of the year but the bulk are born within the three months mentioned. As the cows are now being mated this would put the gestation period at roughly 9 months or the same as domestic cattle.

The breeding season of bison evidently varies considerably with locality. There are plenty of calves to be seen in the bamboo and deciduous forests below us, round about Christmas time. I once watched a herd of bison in bamboo country for the whole of one day. The bulk of the herd lay up in a large patch of bamboo but one cow left them, and wandered off by herself, and eventually went into a small patch of bamboo about half a mile away at about midday. At three o'clock she came out with a new-born calf which was still damp. It could just walk very groggily but got almost visibly stronger every minute. The mother grazed quietly and slowly along just in front of it to join up with the herd again. This was at Christmas time.

There has been a considerable amount of controversy on the subject of solitary bulls. From my last Sunday's observation the master bull was of the type one would expect to find solitary at most times of the year. His opponent was I should say younger as he was not quite so dark in colour but there was nothing to choose in size. Size of head does not apparently necessarily mean victory, as this bull's head was small and from the worn state of

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his horns he had evidently been fighting for some years for his privileges.

It would seem that bison calves when old enough to be herded are discouraged from making a nuisance of themselves to their elders during the resting period of the day and are left in charge of a nurse. I have noticed this several times before, the nurse generally being a three parts grown young bull. Another point on which one hears and reads a number of different opinions is as to whether bison have dewlaps. From observation of a large number of bison there is no doubt that some have and some have not. The bull described above had one of the best developed dewlaps I have ever seen. I am inclined to think that dewlaps are often a family characteristic of bison inhabiting a certain district, but even this is not necessarily a certain characteristic.

Monica Estate,
Nalparai P.O.,
S. India.
J. WILLIAMS.

June 7, 1934.

VI.—GROWTH AND SHEDDING OF ANTLERS IN THE SWAMP DEER (*RUCERVUS DUVAUCELLI*) IN MANIPUR STATE.

Mr. Higgins has made over to me your letter of the 26th January making some enquiries about the Manipuri stag. I have no personal knowledge, but I have had enquiries made among men who are likely to know, and report as follows:

A. Time of shedding antlers—June and July.
B. Period when antlers are in velvet—August and September.
C. Period when clean—January and February.
D. Pairing season—March and April.
E. Time when young are born—October and November.

Imphal, Manipur State,
Assam.
C. GIMSON.

April 9, 1934.

VII.—HOOF DISEASE IN THE MUNTJAC (*MUNTIACUS MUNTJAC*).

The following account of a Muntjac may be of interest to you in as much as the feet were infected with some disease and the 'nails' came off! My dogs are not particularly brilliant and would not have caught him (a male) had it not been in a weak condition, although he was only about a third or half-grown. They caught

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him in the river in the estate and I thought at first it was an otter and I was all out for blood! When I realised what it was I ran to the rescue and was surprised to see several of the hooves had come off whilst the dogs were chasing him. I realised it was a sick animal so killed it and found the remaining hooves came off easily and had grown to an abnormal length. I don't know if it is a common disease and would be interested to hear if you have had similar cases.

KURADY KHAN ESTATE,
SANGAMESWARPET P.O.,
KADUR DISTRICT.
July 14, 1934.

G. V. R. FREND.

VIII.—NIDIFICATION OF THE TRAVANCORE LAUGHING-THRUSH [*TROCHALOPTERON JERDONI FAIRBANKI* (BLANF.)] AND THE BLACK-HEADED BABBLER [*RHOPOCICHLA ATRICEPS ATRICEPS* (OATES)].

In vol. i, p. 140 of Mr. Stuart Baker's *Nidification of Birds of the Indian Empire*, I see I am credited with finding my eight nests of the Travancore Laughing-Thrush in the month of March. This is of course incorrect vide my note in vol. xxxv, p. 204 of the *Journal*, all the nests with eggs or young having been taken between April 23rd and May 19th.

On p. 252 of the same volume Mr. Stuart Baker refers to my remarks on the Nilgiri Black-fronted Babbler wherein I stated that I was inclined to accuse these birds of nesting in colonies. On the same page he quotes Davidson who says 'It seems to spend most of its time building unnecessary nests'. This aspect of the case had not struck me. Davidson is perhaps right and I wrong, though it seems hardly likely that one or even two pairs of these birds would go to the trouble of building seven nests in a row. Further investigation into this point is obviously desirable.

Incidentally 'Mercana' should read 'Mercara', the capital of Coorg.

SHILLONG.
June 20, 1934.

W. BATES.

IX.—THE KING-CROW [*DICRURUS MACROCERCUS PENINSULARIS* (TICEHURST)].

In the Vernay Scientific Survey of the Eastern Ghats (J.B.N.H.S., vol. xxxvi, p. 348), it is said that 'the Survey did not procure specimens of the Black Drongo or Common King-Crow in the Vizagapatam area, but Ball cites Jeypore in his list of localities for it. It is probably generally distributed and resident down the whole of the eastern side of the Presidency. Though the only

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published records refer to Madras itself where Dewar has recorded some interesting notes on its habits (J.B.N.H.S., xvi, pp. 364-6 and 486) '. . . in the rest of the Presidency we certainly require more information about the King-Crow.'

I thought that the following will be of some interest. The King-Crow is one of the commonest birds in the Godavery District. It is always seen either perched on telegraph wires or riding easily on some lazy buffalo or cow. It is a very active bird, always on the wing, flying hither and thither and chasing away enemies far larger than itself—like that blackguard the Crow (whence its name) or even the Common or Pariah Kite. And it beats the lark in its early rising, I have heard the beautiful song of this bird as early as 2 in the morning, during the summer months. And it is equally a hard worker, foraging late into the evening even after sunset. The bird is of course most pugnacious when brooding and most active when bringing up its family. The young ones remain quite a long time with their parents even after the characteristic fork-tail is grown, obeying the harsh screech which is their danger signal and an alternative to their whistling song. Its diet seems to be mostly flies and butterflies and such other insects, but I suspect that along with the local people, it has a partiality for palm-juice or toddy. It either hawks butterflies on the wing or catches little insects from the crevices of palm fronds, and folds of buffalo-hide. In keeping with its royal nomenclature, it always affects the topmost and most conspicuous perch on trees—sitting well outside the foliage. Sitting on such a perch it surveys the land around to dart with lightning speed at some passing swallow-tail. It must surely be thankful to the Government Telegraph Department for erecting those perches without the encumbrance of leaves. Its grandest banquet is when termites emerge in large numbers from an ant-hill.

The bird builds its nest on any tree for it is not afraid of enemies. It selects usually Acalia trees in this district, but also builds on Rain and Tamarind trees. They brood with their forked tail stretching beyond the small cup-shaped nest. The parent birds brood in turns. The following is from my records.

24th April 1926		Discovered nest with 3 eggs ; two large and one small egg.
29th, after 5 days		Birds sitting close.
1st May, after 8 days		Birds getting irritable.
8th May, after 10 days		The smallest egg hatched out.
14th May, after 17 days		All hatched, getting feathers.
22nd May	14 days after hatching	Still in the nest, tail feathers, appearing.
2nd June	25 days after hatching	Left the nest ; within 100 yards of the nest ; just able to fly a little. Tail not yet forked.
5th June		The family is progressing.
8th June	31 days after hatching	Being fed by parents still. Tail still short.

PRESIDENCY COLLEGE,
MADRAS.
April 3, 1934.

A. S. THYAGARAJU, M.A.

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X.—NOTES ON THE HABITS OF THE MAGPIE ROBIN (*COPSYCHUS SAULARIS SAULARIS* LINN.).

The Magpie Robin is one of the most familiar birds in South India and yet there is very little mentioned about its habits in literature. A pair had taken up their abode in the front hedge of the S.P.G. Parsonage at Nangur, Tanjore District, South India, a village some twelve miles from Tranquebar. The distance between the Parsonage buildings and the gate is about 50 yards. The birds sang sweetly and occupied the fence on one side of the gate. In the last week of April this year my attention was drawn by the peculiar sound produced by the pair as they were trying alternately to strike at something about 40 yards from the house on the road leading from the Parsonage to the gate. It had rained the previous day and so I was inclined to think they were catching termites on the wing, but came out to see what the matter was. A green Whipsnake (*Dryophis mycterizans*) was seen on the road with its head raised in a posture ready to strike. The plucky little birds were able to prevent it from moving even an inch, till I despatched it with a stick. A Red-vented Bulbul (*Molpastes haemorrhous haemorrhous* Gmel.) was also in an agitated state hopping from branch to branch, raising its crest, and watching the attack but not feeling bold enough to join in it.

A week or ten days later my attention was drawn a second time by the birds which were producing the same alarming notes. On looking out I found the birds flying about hither and thither and frequently perching on a cocoanut palm on this side of the same road a few feet closer to the Parsonage from the spot where the snake was found. On closer examination an owl (*Strix flammea*) was found to be hiding at the base of the very same cocoanut leaf at the tip of which a Magpie Robin was sitting. The owl which had visited the bungalow during the night had failed to retire and the watchful eyes of the Magpie Robins were able to detect its presence. As they were unable to tackle the bird themselves they did the next best thing i.e., raising an alarm till those more powerful than themselves attended to their enemy.

The breeding season of the Magpie Robin appears to be from March to July. It may be that during this period the birds are more vigilant than at other times. Maternal instinct may force even a weak bird to protect its offspring from imminent danger, but attacking a snake on the road away from the hedge in which the birds had taken up their abode, coupled with their daring in approaching the tree on which the owl had hidden itself makes one feel that the birds are by no means cowards and that they possess the grit in them to put up a fight when the occasion demands it.

Wall, in the Bombay Natural History Society's *Journal*, vol. xxvi, p. 576, mentions an instance when he heard a prodigious hissing and discovered the presence of a black Cobra (*Naia tripudians*) through a window in a hedge, and adds that the 'prodigious hissing' proved to be the scoldings of a Magpie Robin.

Dogs are known to attack snakes and reveal their presence to man. My experience with regard to the Magpie Robin coupled

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with the instance mentioned by Wall, makes me feel that in this bird we have a friend who would inform us of the presence of snakes and attack them if it can.

Ever since the incidents mentioned in this note, I have observed the Magpie Robin more carefully. The Tailor bird (*Orthotomus sutorius sutorius* Forst.) has been reported to be a most confiding bird and it is stated that it frequently nests among the plants in one's verandah. This habit appears to me to be, not only an attempt to escape the depredations of carnivorous birds but still more a desire to court human protection. I have had the chance of noticing these birds in the presence of Magpie Robins. In another part of the Parsonage garden they lived in the same bush along with Magpie Robins and kept up a continuous 'Tweet'. During the day they were seen in various places in the compound and were always along with the Robins. When they flew away the Tailor birds followed them. This I have noticed for over a month. The explanation for this comradeship appears to me to be that the weak Tailor birds court the protecting care of the more daring Magpie Robins. They retire in the same bush and move always together, the Magpie Robins leading.

The Tamil name for the Magpie Robin is *gundoo-karitchan*. *gundoo* means round, and *karitchan* is the Black Drongo (*Dicrurus macrocercus macrocercus* Vieill.). It is possible the Tamilians call it *gundoo-karitchan* because the bird looks round when the tail is lifted up and will look like a Drongo if it is black completely. The pugnacity of the Drongo is well known. It drives away carnivorous birds but weaker birds nest in the same tree and count on the protection it can afford. It is possible that a situation similar to this is found in the association of the Tailor bird and the Magpie Robin though to a less extent.

Whether the name *gundoo-karitchan* has risen as the result of the observation of the Tamilian who has seen the bird attack other birds, I have not been able to find out, but I dare say the Magpie Robin would have attacked the owl when I saw it, but for the protected position the owl occupied.

These notes are communicated in the hope that others may be able to record similar experiences.

'Niton', Letangs Road,
Vepery, Madras.
July 21, 1934.

BONAVIS BONNELL.

XI.—THE NESTING HABITS OF THE SMALL SUNBIRD [*LEPTOCOMA MINIMA* (SYKES)].

On the 5th February, 1934, I observed a pair of these pretty little birds building a nest in my garden at the tip of a slender branch of *Mimusops elenghi*, under an awning of leaves, at a height of about 10 ft. from the ground. The nest has made some progress by that time, so that, it was obvious that it must have

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been begun earlier. It was suspended from the tip of the branch, and was more or less domeshaped, with a circular opening on the treeward side overhung by a hood, apparently meant as a protection against the inclemencies of weather and unwelcome intruders. The nest was made of lichens, fibres, and such other materials.

On the 5th and 6th February, the male was doing all the work, but, on the 7th morning, I observed the female busy working at the nest. The male was merely flying to and fro, covering the female in its flight to get the materials for, as I discovered, lining the nest. The lining was arranged, first with the beak, and then with the feet, the bird entering the nest for the purpose. Almost every time fresh material was brought the process was repeated alternately with the beak and legs. The same activity was observed on the part of the female on the two succeeding days, the male, as before, covering its mate in its flight. The nest building activity was particularly noticeable in the morning on all these days.

On the 10th and 11th I did not see these birds. They appeared to me from the very beginning exceedingly nervous and suspicious. I was wondering whether they had deserted their nest, seeing that they were being watched. To my relief, they were seen again on the 12th morning at about 9 o'clock. The female came to the nest only once or twice. It was evident that the nest had been completed. My observation shows that the coarser part of the work of nest construction, the building of the body, is allotted to the male, the finer part of it, the lining, being undertaken by the female, which, naturally knew better than its mate the requirements of the eggs and nestlings.

At 2 p.m., on the day in question, I saw the female bird alone coming to the nest. It entered the nest and sat inside putting the head and beak out through the opening, which was eminently shaped for the purpose. The male bird could not be seen anywhere in the neighbourhood. The behaviour of the female led me to suspect that it had laid eggs, and when, taking advantage of the bird's temporary absence, I examined the nest at 4-30 p.m., my suspicion was confirmed by the presence of two small dirty white eggs. I had examined the nest the previous evening. There were no eggs then, and there was no doubt that the eggs were laid only this day, i.e. 12th Feburary. The female bird came to the nest almost immediately I finished my inspection of it, and after about 15 minutes, flew away. A little after 5 p.m. I saw the male for a very brief while, sitting on a neighbouring branch of the tree.

From the 13th to the 22nd of February, I saw the female sitting in the nest on and off, the male not being visible anywhere in the neighbourhood. On the 23rd at about 9 a.m. I saw the male again coming with the female. The male bird sat on the branch of a neighbouring tree for a very short while and then flew away. On the 24th the attention of the male became more assiduous. The pair could be seen very often flying together and hovering about the nest. Once I saw the male actually putting its head into the nest. The behaviour of the male, on the whole, gave

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the impression that some great event was impending, and that event could be none other than the hatching of the eggs. This sort of attention on the part of the male continued on the following days, and, every evening I examined the nest to see if the hatching had taken place. On the 1st of March, at about 5 p.m. I saw the pair visiting the nest. I suspected them to be feeding or 'fondling' the nestlings, and the examination of the nest showed that the eggs had been hatched. The incubation period extended from the 12th February to the 1st March, about 18 days.

I found that, although the male visited the nest now and then the feeding and practically all care of the nestlings devolved on the female. I had hopes of seeing the nestlings in their first efforts at flight, but these hopes were not destined to be realised. Unusual for that part of the year, there were a few sharp downpours from the 15th to the 18th March, and as I was otherwise busy on those days, I do not know what happened to them during that period. But certain it is that on the 18th evening, when I examined the nest, which was partly damaged by the rains, I discovered to my great discomfiture that the nestlings were no longer there. I have not seen them or their parents since.

Maharajah's College,
Ernaculam. K. KARUNAKARAN NAYAR, M.A.,
April 4, 1934. *Professor of Zoology.*

XII.—HABITS OF THE KING-VULTURE (*SARCOGYPS CALVUS* SCOP.).

Mr. Ali writing on the habits of the King-Vulture in his recent paper (Hyderabad State Ornithological Survey, vol. xxxvii, p. 425) holds views opposite to those of most ornithologists who preceded him. He says that he has found 'this so called King-Vulture, to be the most cowardly member of the fraternity that usually gathers to a feast, keeping himself aloof from the scrimage, only venturing forward in obvious fear and trembling to tug at a gobbet and withdrawing hurriedly when overwhelmed by the press'. Obviously a case of *lèse majesté*—which suggests a development among Vultures of the modern disregard for the divine rights of kings.

Mr. Morris in his note on the death of an Elephant when calfing, published on page 722 of this number says that he observed five King-Vultures in 'full possession of the carcase while hundreds of their common kindred were perched on the surrounding trees'.

From this one might gather that the disaffection has not spread through all parts of the country—and that there are places where the King-Vulture's claim to supremacy remains undisputed.

Bombay Natural History Society,
Bombay. EDITORS.
August 16, 1934.

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XIII.—A NOTE ON THE APPENDAGES AND BARBS ON THE WINGS OF THE PHEASANT-TAILED JACANA [*HYDROPHASIANUS CHIRURGUS* (SCOP.)].

Mr. W. A. Hewitt of Bihar in his letter to us with regard to the appendages and barbs on the wings of the Pheasant-tailed Jacanas obtained by him says: 'I have examined four immature specimens of the Pheasant-tailed Jacana and in every one of the four birds I found that the first and second primary were produced into a filamentous lanceolate appendage, and the fourth into an attenuated point.'

Mr. Hewitt suggests that the present Fauna of British India is wrong, as are many other books on Indian Ornithology, in assuming that only the first primary ends in a filamentous lanceolate appendage.

On going through the large series of *Hydrophasianus chirurgus* in the Society's collection I find that the present Fauna and all other books on Indian Ornithology seem to have described the Pheasant-tailed Jacana from the first bird at hand.

The characteristics displayed by the wing appendages in Mr. Hewitt's specimens are only confined to immature birds. As the bird grows older, the webs fall off or disintegrate, leaving a featherless barb. The third primary loses its web first, then the second primary and finally, in very old birds, the first.

Mr. Hewitt's observations have led us into other channels. I find that the absence or presence of webs on the primaries gives an indication as to the age of the bird. The older the bird, the less are the webs and even barbs on the primaries. In one old male bird's skin, in the Society's collection, there are no evidences of barbs or webs on any of the primaries. The only constant feature in all birds is the attenuated point in the fourth primary.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY. V. S. LA PERSONNE,
May 5, 1934. *Assistant Curator.*

XIV.—OCCURRENCE OF THE WOOD SNIPE [*SCOLOPAX R. RUSTICOLA* (LINN.)] IN THE CENTRAL PROVINCES.

I enclose the wing of a Wood Snipe shot in the Balaghat Division of the Central Provinces on the 25th February presumably while migrating.

The place and date may be of interest.

RAIPUR, C.P., P. V. CHANCE.
March 3, 1934.

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XV.—A FURTHER AID TO DIFFERENTIATION BETWEEN SWINHOE'S SNIPE [*CAPELLA MEGALA* (SWINHOE)] AND THE PINTAIL SNIPE [*CAPELLA STENURA* (BONAPARTE)].

The similarity in the colouration of Swinhoe's Snipe and the Pintail Snipe frequently leads to confusion of the two species by sportsmen.

The key to the identification is given as:

Tail features 26 in number, never less than 22	*C. stenura.*
Tail feathers 20 in number	*C. megala.*

The above seems ample enough to identify either bird, except when the tails are in moult! Mr. Gimson recently sent us two skins of snipe which he thought were Swinhoe's, on the strength of them not showing any pin-feathers in the tails. Both birds were in heavy tail-moult, and except for the partly-grown 4 central tail-feathers the rest were mere stumps of one millimeter or less. With the aid of a magnifying glass it was possible to count these stumps, which numbered 22. They were therefore the Pintail Snipe.

In the absence of the most essential features of differentiation between these two birds, I have found, on examining the series in the Society's collection, that there is one constant feature which will be an aid to differentiation between these two snipes. The following key was sent to Mr. Stuart Baker for verification.

Longest feather in bastard: wing never under 20 mm.	*C. megala.*
Longest feather in bastard wing never over 17 mm.	*C. stenura.*

Mr. Stuart Baker has sent the following letter:

'You are quite right about the bastard wing of *C. megala* and *C. stenura* and I find my notes say—Bastard wing of *C. megala* (Swinhoe's) never under 20 mm.; that of *C. stenura* (Pintail) never over 18 mm.

A very good key would be:

A. Bastard wing always over 19 mm. ...	*C. megala.*
B. Bastard wing always under 19 mm. ...	*C. stenura.*'

In view of the little known habits and distribution of Swinhoe's Snipe and the possibility of it being overlooked in large bags, the above key it is hoped will help sportsmen towards a correct identification in the future.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY.
May 25, 1934.

V. S. LA PERSONNE,
Assistant Curator.

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XVI.—OCCURRENCE OF THE PURPLE WOOD-PIGEON [*ALSOCOMUS PUNICEUS* (TICKELL.)] IN SINGHBHUM DISTRICT, BIHAR AND ORISSA.

I am sending you two skins of what I believe to be Purple Wood-Pigeon (*Alsocomus puniceus*) shot in the Saranda forest division of Singhbhum district on the 12th May.

Speaking from memory, I think the only record of the occurrence of this bird is that of Col. Tickell, referred to in Stuart Baker's 'Indian Pigeons and Doves'. Tickell was Deputy Commissioner of Singhbhum sometime in the 'fifties and I have heard of no other reference to the bird's existence in the district. For some years past I have endeavoured to verify the original record in Singhbhum and the adjacent States of Orissa, but hitherto without success.

It appears that this pigeon is not alone very rare but is extremely local; although where I encountered it I saw no less than thirty or forty birds. They inhabit a few cool valleys at about 2,000 ft. elevation in *sal* forest characterised by a dense evergreen undergrowth consisting mainly of *Litsaea nitida* and *Symplocos spicata*, and watered by fresh perennial streams. The local people, Hos, know the bird as *gara putam* and say that it is never found outside three or four high valleys where this type of forest is met with.

When found by me the birds were congregated feeding on the unripe fruits of *Litsaea nitida;* and the crops of both specimens shot were full of the berries. The birds were not particularly shy and kept moving in short flights as I followed them: soon settling down to feed if not approached too close. Their flight is not very rapid, rather resembling that of the Green Imperial Pigeon; and their call is also rather similar to that bird, though the note is not so low nor so prolonged.

I have not heard of the occurrence of this bird elsewhere in the province but I should think it not improbable that it might be found in the higher hills of Mayurbhanj and Bonai States, the latter adjoining Singhbhum on the south.

The Green Imperial Pigeon does not appear to occur in this district or elsewhere in Chota Nagpur; although I have seen it forty miles further south and thence throughout the forest tracts of Orissa to the northern borders of Madras.

CAMP THOLKOBAD,
SINGHBHUM DISTRICT.
May 14, 1934.

H. F. MOONEY,
I.F.S.

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XVII.—THE DAWN CAROL OF BIRDS.

Observations of the dawn carol on April 17th, 1934.

At 10 minutes to 5 a.m. the Mynas began to make a noise. They stopped it for 10 minutes and then began again and stopped after 15 minutes.

The Jackdaws (*Corvus monedula sommeringii*) joined in.

At 5-20 a.m. Tickell's Thrush began its song and was joined in after a few seconds by the Great Tit.

Sparrows took part in it and the concert was in full swing until 10 minutes to 6 a.m.

Then there was a silence.

This place of observation is east of Srinagar towards the lake side.

On May 28th.

At 4-35 a.m. The silence was broken by Mynas, 10 minutes after, rose the song of Tickell's Thrush and was followed by the Golden Oriole's song. By this time the concourse of finches was great. The Ringdove lifted its note and the short and pleasing warble of the Paradise Flycatcher and the singing of the Bulbul added more tunes to the morning song. The Great Tit joined in and the Hoopoe was the last bird to join the concert.

The song died away slowly at 5-35 a.m.

The sun rose at 6-10 a.m.

On June 3rd.

Observations were taken in a boat on the Dal Lake near Srinagar.

During the night we heard several deep 'wak' calls of a Heron (Night Heron or Common Heron). At 3-55 a.m. the silence of the dawn was broken by Tickell's Thrush and was soon after joined in by the Golden Oriole. I could not recognise the shrill call of some bird coming from a poplar tree. At 4-30 a.m. the Great Reed Warbler (*Acrocephalus stentoreus*) joined the chorus.

The chorus slowly died away.

The sun rose at 6-10 a.m.

The following observations of the serial succession of bird songs at dawn were taken on 4th June at Srinagar in the gardens of the Rev. Canon Tyndale-Biscoe and Mr. F. Jacob, which are adjacent to each other. The gardens are full of plant life of almost all dimensions from small bushes to tall stately trees and present the aspect of a forest or woodland interspersed here and there with lawn. The place is a bird sanctuary. What a joy it gives to an early riser to hear the sweet symphony into which in all probability he merges his own soul!

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TIME	NAME OF THE BIRD	REMARKS
4-15 a.m.	Tickell's Thrush (*Turdus unicolor*).	This bird began with a sweet and soft note.
4-21 a.m.	Do. do. ...	More than half a dozen joined the chorus with high notes.
4-30 a.m.	The Golden Oriole (*Oriolus oriolus kundoo*).	
4-32 a.m.	The House Crow (*Corvus splendens zugmayeri*).	This bird gave only two calls (caw).
4-35 a.m.	The Golden Oriole ...	
4-40 a.m.	Do. ...	The second bird.
4-45 a.m.	The Ringdove (*Streptopelia decaocto decaocto*).	
	Sparrows (*Passer domesiticus parkini*).	
	The House Crow ...	Second time.
4-50 a.m.	The Ringdove ...	
4-51 a.m.	The Ringdove ...	Second from a different quarter. Third.
	The Bulbul (*Molpastes leucogenys leucogenys*).	
	The Great Tit (*Parus major kaschmiriensis*).	
	The Mynas (*Acridotheres tristis tristis*).	
5-0 a.m.	The Ringdoves ...	Sometimes by turns, sometimes together.
5-1 a.m.	? ? ?	
5-10 a.m.	The Paradise Flycatcher (*Terpsiphone paradise leucogaster*).	Joined the concert.
5-11 a.m.	Tickell's Thrush ...	Alighted on the lawn to feed.
		Chorus began to melt.
	The Mynas ...	Noise.
	The sun rose at 6-5 a.m.	

Dr. Brut observed the Himalayan Cuckoo's song at 3-50 a.m. at Islamabad 35 miles S.-E. of Srinagar.

C.M.S. HIGH SCHOOL,
SRINAGAR,
KASHMIR.
June 19, 1934.

S. C. KOUL.

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XVIII.—THE MIGRATION OF WILD FOWL, THE SOCIETY'S BIRD RINGING SCHEME.

Since the publication of vol. xxxvi, No. 2, two recoveries of Ringed Birds have been reported by the Director, The Bird Banding Bureau of Moscow, 13 Argo-biostation, Moscow.

One recovery of the Glossy Ibis (*Plegadis falcinellus falcinellus*) ringed in U.S.S.R. was recovered by Capt. Wright at Deolali.

Place Ringed.	No.	Date Ringed.	Species.	Ringed by	Date Recovered.	Locality.	Remarks
Manchar Lake.	3354	23-1-29	*Chaulelasmus streperus*. ♀ (Adult)	R. B. Maclachan.	9-3-31	Ust-Yuish Region. 54°5′ E. L. and 64°20′ N.L. U.S.S.R.	
Manchar Lake.	2673	25-1-29	Mercara Penelope Adult. ♂.	R. B. Maclachlan.	7-5-29	Village Yary Lino. Region Kalpach Evsk. Circuit Tomsk. W. Siberia.	
Astrakhan Volga Delta	3929 D.	7-7-31	*Plegadis f. falcinellus*. (Juvenile)	Bird Banding Bureau Moscow.	14-3-34	Dodlali.	The distance flown is roughly 2,800 miles.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY.
August 16, 1934.

EDITORS.

XIX.—ANGLING OF CROCODILES.

In Kottayam, a village near Tellicherry, North Malabar, there is a large pond which is an abode of hundreds of crocodiles. It is not exactly a pond as the dimensions are so big that it can be termed a lake. Once I happened to see some people engaged in capturing a crocodile.

Their method of catching these animals is mainly by angling. In the place of a float, used in fishing, two pieces of plantain-tree

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stems two or three feet in length tied together served as the float. To this float is firmly fixed an iron hook which is similar in shape to the ordinary fish-hook but has more barbs and is as big as the handle of an umbrella.

The float together with the hook attached, is floated to the centre of the lake by a man in a small canoe. He fixes a moderately large piece of flesh to the hook. The hook is so fixed to the float that the piece of flesh just touches the water. The man then leaves the whole thing there and returns to the bank. The free end of the rope is held by the people on the bank.

After a while a crocodile comes out and takes the bait. The barbs fasten to the floor of its mouth and the helpless reptile struggles vainly. Now the men on the bank holding the rope pull it towards the land. They drag it out of water and beat it to death. This method of catching crocodiles is familiarly known in the vernacular as *Kalam*.

GOVERNMENT MUSEUM,
MADRAS. T. V. SUBRAHMANIAM, B.A.
July 18, 1934.

XX.—NOTES ON THE INDIAN MONITOR (*VARANUS MONITOR*) AND FLYING LIZARD (*DRACO MACULATUS*).

I am sending you under separate cover the skin of a lizard for identification. I am pretty sure in my own mind that it is a small specimen of the Common Monitor Lizard which is fairly common in the Hills (the Anamallai Hills) but is not often seen. This particular specimen was noticed wandering about the verandah of a stone-built bungalow and was killed in the bedroom of the wife of the owner of the bungalow. As a matter of interest I should be glad to know whether the diet of this lizard is known to include ants. This particular bungalow and garden is infested with millions of the small black ant and also has a goodly sprinkling of white ants. The bungalow servants and also the office staff were emphatic that the lizard was not a monitor the Tamil name for which is *udumbu* but stated that it was a lizard that lived on ants by sticking out its tongue to which they stick. I fancy they were guessing at its habits, but there was a curious persistence of the tale that there were three kinds of lizard like the Udumbu—this one being an ant-eater. The local jungle tribes and also most of our outcaste labour forces from the plains are very fond of the Monitor Lizard as a delicacy. When caught they do not as a rule kill them outright but break all their legs and tie them into knots like a whiting. The lizard is then cooked alive in its skin at leisure, a hideously cruel habit but possibly not much worse than the usual methods of cooking lobsters, prawns or shrimps.

I once caught a Monitor Lizard when tracing a road through the middle of a 300-acre clearing of evergreen jungle which had

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just been burnt. This lizard had lived right through the fire and except for a few burnt toes which snapped off on being pressed and a small fire scar near the tail was unhurt and in good condition. When it is realised that it is not possible to get into a burnt clearing for 3 or 4 days after the burn and that even then one is apt to find boot-soles burnt through after the day's work it seems incredible than anything could live through the fire.

Whilst in Bombay in December I mentioned the matter of a flying or gliding lizard which is fairly common here to Mr. Prater I should be glad to know whether the society has any specimens. Should there not be any specimens in Bombay I will try and collect some although they are very difficult to catch as they seem to spend most of their life at the top of tall trees. I had the opportunity of observing a very fine and unusually large specimen at fairly close quarters last week. It happened to finish a glide on the side of a dady tree close to me and I watched it make a leisurely way up the tree. I have noticed before what I took to be the shooting out of a long tongue as the animal travels up a tree, which shows up a bright yellow colour in the sun. On this occasion I was close enough to see that this is not a tongue at all but a small auxiliary parachute web on both sides of the neck immediately under the head which shows up a bright yellow colour when the sun shines through it. This web is expanded and contracted at frequent intervals as the lizard climbs the tree and except at close range would be mistaken for the tongue. The main parachute along the ribs remains folded and unnoticeable, in the same way as a cobra's hood, when the lizard is climbing.

Colonel Fraser, I.M.S., from Coimbatore caught a fine specimen about this time last year when hunting for dragon-flies up here. He told me that he had set it up and was I believe going to send it to you.

Monica Estate,
Valparai P.O.,
S. India.
April 18, 1934.

J. WILLIAMS.

[The skin sent by Mr. Williams was that of the Common Indian Monitor (*V. monitor*). The lizard referred to is the Flying Lizard (*D. maculatus*), a specimen of which was subsequently received.—Eds.].

XXI.—NOTES ON INDIAN MONITORS IN THE UNITED PROVINCES.

I am afraid that I have never made much of a study of lizards and my information on the subject is sketchy.

In the four divisions I know well—Lansdowne, Dehra Dun, North Kheri and Bahraich—large lizards of all kinds except crocodiles appear to me to be distinctly scarce, although there are many species of small lizards. There used to be a fair number of *Goh*

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(*Varanus monitor*) at Nauri in Lansdowne but they seemed to get scarcer year by year. In Dehra Dun and North Kheri I only came across odd specimens at fairly long intervals and in Bahraich I have not so far seen a single one. *Varanus flavescens* may occur in water-logged areas in Bahraich, but if it does, it must be uncommon as nobody here seems to know anything about it and I have personally seen none at all. There used to be large numbers of an iridescent greeny-blue lizard that lived on stone walls in Lansdowne. This reptile was up to 2 ft. long and I don't know its scientific name, but the 2nd/20th Burma rifles came to Lansdowne Cantonment and their men captured and ate practically the whole lot. This battalion has now left the cantonment and the species may be recovering again, but from being very common it had become scarce when I left there in 1929. The Burma rifles may also have been the cause of the disappearance of *Varanus monitor* from Nauri.

I do not know accurately the position as regards the abundance or otherwise of *Goh* in divisions where I have not been posted, but I am under the impression that they are not particularly common anywhere inside reserved forests. The breeding season is not absolutely definitely known but it is almost certainly late in the hot weather or at the beginning of the monsoon.

In view of the fact that *Goh* are not generally particularly common inside reserved forests and that a merciless campaign against them is being waged in many places outside the forests where control is much more difficult, may I suggest that, instead of trying to enforce a close period for an uncertain breeding season, we should forbid the *commercial* exploitation of lizard skins altogether from reserved forests? I mean by this that Divisional Forest Officers should not give permission for any one to capture lizards with the object of selling their skins from anywhere inside the reserved forests. This will not result in any loss or interfere with the present trade in lizard skins, and the few *Goh* that we have will thus be protected and form a reservoir from which a certain percentage will certainly stray outside and probably be captured.

It is sometimes said that *Goh* are destructive to the eggs of Jungle Fowl and Kalej Pheasant. I do not know definitely how far this is true but it is a fact the Nauri in Lansdowne division is the best place I know for Kalej and it is (or rather used to be) also the best place I know for *Goh*. It may be that because *Goh* eat Kalej eggs, they used to collect at Nauri, but in any case the stock of Kalej there did not seem to suffer from their depredations. With the limited number of *Goh* that we have inside reserve forests I do not think the question of their possible destructiveness to game-birds need be taken into consideration.

I am afraid that this is not a very valuable note but I will try to collect some more information on the subject.

DIVISIONAL FOREST OFFICE,
BAHRAICH DIVISION, U.P.
June 15, 1934.

F. W. CHAMPION, I.F.S.

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XXII.—OCCURRENCE OF THE SIX-TOED FROG (*RANA HEXADACTYLA* LESSON) IN THE BOMBAY PRESIDENCY.

On the 25th February this year in company of Mr. H. Ali and his cousin, I visited the Karnala Fort (Funnel Hill in the Kolaba Dist. While in quest of natural history specimens I noticed some frogs in one of the rock-cut reservoirs. At first I took them to be the ordinary Water Skipper (*Rana cyanophlictis* Schneider) but they appeared larger and heavier in build and did not skim the water in elegant 'skipper style'—the jumps were more laboured and not so long. Not having a net I shot two of them as they floated on the surface. They immediately sank to the bottom from where Mr. Ali was fortunately able to retrieve them, as they were only wounded.

Once they were in my hand I immediately recognised that they were not the Water Skipper but the Six-toed Frog (*Rana hexadactyla*). On examination both proved to be gravid females. The eggs were well advanced and would have in all probability been deposited in a short while. It is curious that these frogs should be gravid at this time of the year, but this might be explained by their totally aquatic habit in which case they may possibly breed the year round when favourably situated. The cisterns have water all the year round. It is interesting to note that the frogs were commoner in those cisterns which were exposed to a certain amount of sunlight—the frogs would bask in the sun as they floated. Karnala is 1,560 ft. high.

As far as I am aware this constitutes the first record of *Rana hexadactyla* in the Bombay Presidency.

Subsequent to this discovery, Mr. Ali brought me a single immature specimen which he secured under stones in a pool of a drying nulla at Apsoli, Alibag, Kolaba Dist., on the 12th May of this year.

Possibly this species is not at all rare in the Presidency but has been probably mistaken for its cogener *Rana cyanophlictis* which it closely resembles.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY.
October 16, 1934.

C. McCANN,
Assistant Curator.

XXIII.—OCCURRENCE OF LEITH'S FROG (*RANA LEITHII* BOULENG.) IN SALSETTE ISLAND.

On the 14th October this year I secured three specimens of *Rana leithii* at the Kanari Caves (1,300 ft.), Salsette Island. In my paper *Notes on Indian Batrachians* (J.B.N.H.S., xxxvi, 167), I recorded this rare species from Khandala, Western Ghats. One of the specimens was caught as it was crossing some dry rocks,

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the other two were found in damp places near some of the rock-cut cisterns. The one crossing the rocks was pale yellowish brown, much like the Khandala specimens, but those caught near the cistern were dark brown (they all turned pale on preservation) simulating the colour of the rocks. A blackish band extended along the upper mandible to the tympanum. The skin was covered with small warts particularly in those which were caught at rest near the cisterns.

This frog is extremely active in its movements and is able to take considerable jumps particularly when disturbed, but tries to hide itself at once.

The Kanari Caves is apparently a good ground for Amphibians as I have taken some of the rarer species in the locality.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY.
October 16, 1934.

C. McCANN,
Assistant Curator.

XXIV.—RAT-SNAKES AND THEIR FOOD VALUE.

Rat-snakes (*Pytas mucosus*) are commonly eaten in some parts of North Malabar. They call it by the name *Paramba vala* or *Kara vala* thereby meaning in English 'Land eel'. The term 'eel' applied to a snake is surely misleading but it must be due to the external resemblance in shape that they call it so.

Two or three men surround a snake and catch it with their hands. Then they pull the animal through a hole in a cocoanut shell in such a way that the tail end passes through the hole first. By so doing the animal is not only killed but its scales also removed. The head portion is cut away and the rest is used as meat.

GOVERNMENT MUSEUM,
MADRAS.
July 18, 1934.

T. V. SUBRAHMANIAM, B.A.

XXV.—EFFECT ON MAHSEER OF EATING THE FRUIT OF THE KALAW TREE (*TARAKTOGENOS KURZII*).

There are numerous species of mahseer found in Burma. The commonest Burmese names for mahseer are *nganangyaung, ngatha-lein* and *ngatauk*. A very widely-spread belief prevails among Burmans that mahseer caught in streams which flow through certain evergreen forests are poisonous if eaten. Mahseer when found in such streams are called *ngatauk*. The poisonous effect is said to be due to the fish eating the fruit of the *kalaw* tree. If any one eats a mahseer from such a stream it has a delirious effect

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as the name '*ngatauk*' implies. '*Nga*' means fish and '*tauk*' means to be giddy. Two streams where the mahseer are 'poisonous' in this way are the Kodan and the Nankamu in the Upper Chindwin District. These streams are left bank tributaries of the River Chindwin; they flow through dense evergreen forest in which the *kalaw* tree is plentiful. There are other tributaries of the Chindwin River in which mahseer are also called *ngatauk*. Here also the fish are said to be poisonous, but most of the streams draining the right bank of the Chindwin flow through ordinary deciduous forests; the fish from these streams are edible and in these streams mahseer are locally called *nganangyaung*.

U Pe Kin, Extra Assistant Conservator of Forests, while working near the Nankamu stream was told by the local inhabitants that the flesh of the *ngatauk* from that particular stream was very poisonous. He did not believe what he was told and ate one of these fish. He became seriously ill. He says that the effect was similar to that of drinking country spirits—'I felt very giddy and slightly delirious. . . . Many of the Chin coolies ate the fish and they all suffered in the same way. One of the Chins died two days later. The Chins said it was the fish, but after making enquiries it was found that he ate only a small quantity. The death was in my opinion due to pneumonia.'

U Pe Kin, in the course of his researches on this subject, has eaten *ngatauk* from streams on either bank of the Chindwin and he is now convinced that what the jungle Burmans say is correct, namely that it is only the fish found in streams which flow through forest in which the *kalaw* tree is plentiful that are poisonous and he has come to the conclusion that the local Burmans have two names for the same fish namely *ngatauk* in streams flowing through *kalaw* jungle and *nganangyaung* in other streams.

A European Assistant of a firm of timber lessees was seriously ill some years ago due it is said to eating a mahseer caught in the Kodan stream.

The oil derived from the fruit of the *kalaw* tree has valuable properties. It is used very largely in the treatment of leprosy.

MAYMYO.
June 7, 1934.

S. F. HOPWOOD, I.F.S.,
Chief Conservator of Forests, Burma.

[J. F. Rock writing on 'The Chaulmoogra-Tree and some related species' in United States Department of Agriculture Bulletin, No. 1057, p. 18, says:

'Bears also (author has previously referred to Monkeys) are very fond of the fruit flesh, and large numbers of them roam the forests in search of kalaw fruits. . . . The heavy rains wash the large and often buoyant seeds into the creek and thence into the Khodan stream, the fish of which feed on them. The natives stated that they dare not eat any fish from the Khodan stream, as it would produce the same effect as the eating of a number of fresh kalaw seeds. Wild pigs are also fond of the seeds, and the natives refrain from eating pork at the kalaw fruiting seasons, as the flesh

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of pigs which have fed on kalaw seeds is poisonous, producing nausea and vomiting.'

'It is well to bear in mind that the seeds of all these species (of *Taraktogenos* and *Hydnocarpus*) so far examined have been found to contain cyanogenetic glucosides, which liberate small quantities of prussic acid when the seeds are ground up in a moist condition, and that the oils they contain are toxic. It is on record, for example that a Hydnocarpus oil imported into Hamberg in 1911 and used for the manufacture of edible products gave rise to poisoning cases'—Kew Bulletin (1926), p. 20.—EDS.].

XXVI.—A HUNTING WASP ATTACKING A SPIDER.

Apropos of the story of the Hunting Wasp and Trapdoor Spider, published on pages 239 and following of your *Journal*, issue dated the 15th April last.

In a jungle of the Central Provinces I once saw a large spider racing over a bare patch of dried earth, pursued by a big emerald and green wasp. When the wasp swooped down on the spider, the latter flung itself on its back, and held the wasp 'at arms' length, the wasp trying in vain to reach the spider with its sting. The spider then threw off its enemy and made another bolt for safety. Down came the wasp again and again the spider repeated its former tactics. This happened, as far as I remember, three or four times, until, in a last lap, the spider gained a crack in the ground and the wasp retired, defeated.

UDAIPUR, MEWAR. C. G. CHEVENIX TRENCH.

May 12, 1934.

XXVII.—SOUND PRODUCED BY TERMITES AT WORK.

Col. F. P. Connor's note in the *Journal* on page 1018 (vol. xxxvi, No. 4) on 'Rhythmic sound produced by Termites at work', reminds me of a similar observation I made, while at Peddapuram, a town about ten miles north of Cocanada. This place is famous for its large white-ants, known as *Gorre-chedalu* in Telugu. They build huge ant-hills inside dark rooms. Their presence is usually known by a burring sound, and that is a sign that our best books are being devoured. This sound is quite distinct and is audible even in the daytime, for these termites work at all times provided the place is dark. The sound may be compared to a harsh grating noise *bur bur bur*, indeed the name *Gorre* is I imagine an attempt to indicate it.

PRESIDENCY COLLEGE,
MADRAS. A. S. THYAGARAJU, M.A.

February 28, 1934.

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XXVIII.—A CENTIPEDE KILLING A MOUSE.

My family, servants, and I witnessed an extraordinary sight this morning at 8-30 a.m. and that was a 6 inch red centipede kill a full grown mouse inside a fruit basket containing green mangoes. The centipede held both hind legs of the mouse so that it could not move and buried his legs along the length of its body and fixed his nippers or whatever they are called in the mouse's neck killing it in about five minutes. We had heavy rain last night and that must have driven the centipede into the verandah and the basket.

HARIPUR P.O.,
KHERI DISTRICT, U.P.
June 6, 1934.

L. D. W. HEARSEY,
Captain.

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PROCEEDINGS.

BOMBAY NATURAL HISTORY SOCIETY.

A meeting of Members of the Bombay Natural History Society and their friends was held at the Prince of Wales' Museum on Wednesday, the 22nd August, at 6-15 p.m. Mr. J. G. Ridland presided.

The Honorary Secretary, Mr. H. M. McGusty, announced the election of 46 members since the last meeting held on 19th March 1934.

Mr. T. Sinclair Kennedy, Bombay; Mr. Harold N. Sidney, Bombay; Dr. [illegible] V.C., V.D., Calcutta; Major D. M. Fraser, I.M.S., Cawnpore; Capt. Sardar Bhimrao Nagojirao Patankar, Satara.

Mr. Stanley Jepson then delivered his lecture on 'Wild Animals and their Ways'.

The lecturer dealt with some fascinating features of the animal mind and disputed problems. Speaking of the oft-mooted point whether wild animals possess a sixth sense which enables their subconscious mind to register the evil intentions of poachers, sportsmen or even of the carnivora, Mr. Jepson said many people had enlarged on the theory including Col. A. T. R. Glasfurd, who, in his last book had devoted several pages to it. After a lifetime of shikar Col. Glasfurd was convinced that certain animals did possess this mysterious sense.

'He must have known I had a rifle', was a remark often heard when sportsmen related their experiences of animals who remained still until the last minute following careful stalking and then cleared off. Mr. F. W. Champion in his last book had stated that he found the same problem in stalking animals to photograph them. It was always when he was about to take a picture that the animal fled. M. Jepson thought that the explanation was that the animal mind merely feared the attentions of humanity, good or evil, in the same way that a child resented being made a fuss of by a stranger. It was the fear of the unknown.

Curiosity in animals, especially the deer, often led to their losing their lives to carnivora or hunters. This the lecturer said, was more marked in the female.

Dealing with the larger carnivora the lecturer produced a panther cub and said observation of its habits showed how potent a factor instinct was in animal movements. Even though kept as a pet since it was a week old, the cub could not walk straight across a room but had to stalk under chairs and

WILD ANIMALS OF THE INDIAN EMPIRE.

Part III of this serial will appear in the next Number—Eds.

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XXVIII.—A CENTIPEDE KILLING A MOUSE.

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HARIPUR P.O.

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A meeting of Members of the Bombay Natural History Society and their friends was held at the Prince of Wales' Museum on Wednesday, the 22nd August, at 6-15 p.m. Mr. J. G. Ridland presided.

The Honorary Secretary, Mr. H. M. McGusty, announced the election of 46 members since the last meeting held on 19th March 1934.

Mr. T. Sinclair-Kennedy, Bombay; Mr. Harold N. Sidney, Bombay; Dr. Ram Narain Sewal, Pauri; The Honorary Secretary, E.I. Rly. European Institute, Dhanbad; Capt. H. P. E. Waters, Bombay; Mr. R. E. Parsons, Assam; Capt. W. T. Dixie, I.A.S.C., Karachi; Mr. L. G. D. Wakely, Karachi; Mr. Donald G. Hill, F.R.G.S., Bombay; Mr. W. A. Hewitt, Samastipur; Major-General S. B. Pope, C.B., D.S.O., Poona; Mr. A. E. Hubbard, Asansol; Capt. J. Lindsay Smith, Quetta; The Principal, Pittapur Rajah's College, Cocanada; Mr. R. A. Dyson, Bombay; Mr. M. J. Hackney, Bombay; Mr. M. C. Jacob, I.F.S., Gauhati; Mr. H. A. Keatinge, Kurseong; Mr. A. F. W. Humphrys, Karachi; Mr. E. Raghavendra Rao, Nagpur; Mr. V. S. Rao, I.F.S., Jalpaiguri; Mr. R. B. Carrick, Madras; Capt. C. Harford, Simla; The Librarian, J. N. Petit Institute, Bombay; Mr. H. V. Blackburn, Manipur; H. H. The Maharaja of Orchha, Tikamgarh; The Raja of Jaunpur, Jaunpur; Mr. H. E. W. Braund, Rangoon; The Principal, Lawrence Memorial Royal Military School, Lovedale; The Raja and Ruling Chief of the Feudatory State of Ranpur State; Ranpur; Mr. G. B. Baksi, I.F.S., Bhandara; H. H. The Raja Saheb of Nilgiri State, Raj-Nilgiri; Mr. E. S. Lewis, M.B.E., I.C.S., Lyallpur; The Inspector-General of Forests, H.E.H. the Nizam's Dominions, Hyderabad; H. H. the Maharajadhiraj of Sirohi, Sirohi; Mr. L. G. Redmond, M.I.C.E., Bombay; Mr. C. J. West, Bombay; Mr. D. Davis, Bombay; Mr. A. L. Terry, Bombay; The Director of State Gardens, Gwalior; The Raja Saheb of Bhinga Raj, Bhinga; Mr. S. A. Vahid, I.F.S., Khandwa; The Raja of Baudh State, Baudhraj; Col. A. M. Leake, V.C., V.D., Calcutta; Major D. M. Fraser, I.M.S., Cawnpore; Capt. Sardar Bhimrao Nagojirao Patankar, Satara.

Mr. Stanley Jepson then delivered his lecture on 'Wild Animals and their Ways'.

The lecturer dealt with some fascinating features of the animal mind and disputed problems. Speaking of the oft-mooted point whether wild animals possess a sixth sense which enables their subconscious mind to register the evil intentions of poachers, sportsmen or even of the carnivora, Mr. Jepson said many people had enlarged on the theory including Col. A. T. R. Glasfurd, who, in his last book had devoted several pages to it. After a lifetime of shikar Col. Glasfurd was convinced that certain animals did possess this mysterious sense.

'He must have known I had a rifle', was a remark often heard when sportsmen related their experiences of animals who remained still until the last minute following careful stalking and then cleared off. Mr. F. W. Champion in his last book had stated that he found the same problem in stalking animals to photograph them. It was always when he was about to take a picture that the animal fled. M. Jepson thought that the explanation was that the animal mind merely feared the attentions of humanity, good or evil, in the same way that a child resented being made a fuss of by a stranger. It was the fear of the unknown.

Curiosity in animals, especially the deer, often led to their losing their lives to carnivora or hunters. This the lecturer said, was more marked in the female.

Dealing with the larger carnivora the lecturer produced a panther cub and said observation of its habits showed how potent a factor instinct was in animal movements. Even though kept as a pet since it was a week old, the cub could not walk straight across a room but had to stalk under chairs and

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slink about. It carried things backwards in the same way as a large tiger dragged a carcase. Speaking about the disputed point whether panthers had scent, Mr. Jepson said his experiments with the cub showed that it had no scent.

In conclusion, Mr. Jepson made a plea for legislative action towards the conservation of India's very rich and varied fauna. The causes of the present marked diminution of wild life, he said, were the production of cheap rifles, the commercialised value and marketing of things like venison, hides and horns, the growth of poaching partly due to the large number of 'crop protection rifles', which were often used for supplying villagers with meat, the inevitable spread of cultivation of erstwhile forest areas and the lowered ethics of present-day shikar, shooting from motor cars.

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Wavy-leafed Tecomella.
Tecomella undulata, Seem.
(about 2/3 nat. size)

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JOURNAL
OF THE
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April, 1935. Vol. XXXVII. No. 4.

SOME BEAUTIFUL INDIAN TREES.

BY

The late E. Blatter, s.j., ph.d., f.l.s.,
and W. S. Millard, f.z.s.

Part XVII.

(*With one coloured and one black-and-white plates*).

(*Continued from page 514 of this volume*).

Plate XXV.—Wavy-leafed Tecomella.

Popular names: Rori (Bal.); Lohero (Sind); Lahura (Punjab); Roheri, Roira (Merwara).

Tecomella undulata Seem. in Ann. & Mag. Nat. Hist., ser. 3, vol. 10 (1862), p. 30. *Tecoma undulata* G. Don, Gen. Syst. V. H. (1837), p. 223.—Belongs to the family *Bignoniaceae*. *Tecomella* is derived from the generic name *Tecoma* itself derived from the Mexican name of a plant: *Tecomaxochitl* (*tecomatl* = vessel + *xochitl* = flower).

Description: A large shrub or small tree with drooping branches and greyish green foliage. Leaves 2-5 by ⅜-1¼ in. narrowly oblong, blunt at the apex and with wavy margins, covered with minute hairs and slightly rough; leaf stalk 1 in. long. Flowers large, from pale yellow to deep orange; inodorous, in smaller or larger 5-10 flowered bunches at the ends of the smaller lateral branches; stalks ¼-½ in. long, cup-shaped with 5 almost equally rounded lobes, veined. Stamens 4, filaments smooth. Stigma divided into two lobes. Fruit 8 in. long by ⅜ in. broad, slightly curved, parallel sided, smooth and sharply pointed at the tip. Seed winged 1 by ⅜ in. (including the wing), wing thin, very narrow, rounded at the top and absent at the base of the seed.

Distribution: India, Western Peninsula, Punjab, Rajputana, Baluchistan; Arabia.

Gardening: A very handsome tree when in full bloom and really worthy of cultivation. It is easily propagated from seed or

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cuttings (Troup). It is not uncommon in the drier tracts of India, flowering between February and April.

Uses: The bark is employed in Sind as a remedy for syphilis. The leaves are eaten by cattle. The wood is strong, tough and durable; takes a fine polish, and is highly prized for furniture (Watt. Dict. Econ. Prod.). The wood is yellowish brown, mottled, handsome, highly-prized for furniture, carving and agricultural implements (Brandis). It is drought-hardy and very resistent to fire. It would be a useful species for afforesting dry tracts (Troup).

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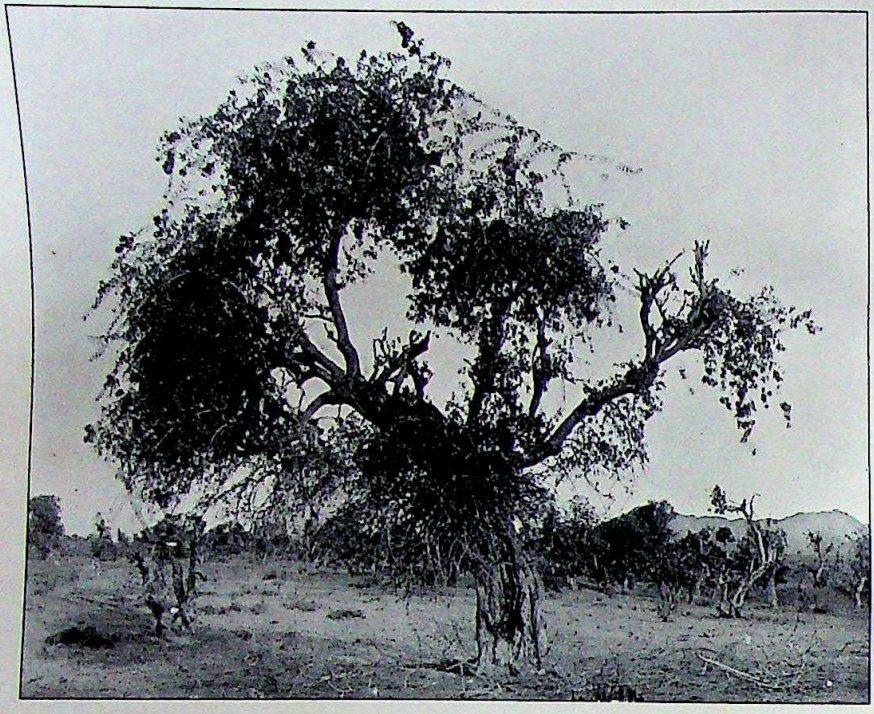

Wavy-leafed Tecomella (*Tecomella undulata* Seem.) Tree in flower, Maval, Rajputana.

Flowers of the Wavy-leafed Tecomella (*Tecomella undulata* Seem.)

Photos by C. McCann.

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THE VERNAY SCIENTIFIC SURVEY OF THE EASTERN GHATS.

(Ornithological Section).

BY

Hugh Whistler, M.B.O.U., assisted by N. B. Kinnear, M.B.O.U

Part X.

(*Continued from page 528 of this volume*).

[**Psittacula eupatria** Linnaeus.

Psittacus eupatria Linnaeus, Syst. Nat., ed. xii (1766), p. 140—Gingee.

The Large Parakeet is said to occur in the Presidency, but the fact never appears to have been properly verified. Jerdon says that it is found in the forests of Malabar, in the Northern Circars and occasionally in parts of the Carnatic. Stewart is said to have found it in Travancore though none of the other observers in that State record it.

In the *New Fauna* (vol. vii, p. 339) the type locality is given as Ceylon. It should, however, be Gingee as Linnaeus based his description on the *Psittaca ginginiana* of Brisson (Aves, iv, p. 343).

The arrangement of the races of this species in the *New Fauna* does not appear to me to be satisfactory. Birds from Sikkim and the Duars are attributed to the race *indoburmanica*, as are also birds from Burma generally. I have examined a good series of these Parakeets from the Sikkim-Duars area and cannot find that they differ in any particular from *Psittacula e. nepalensis* (Nepal, Punjab, United Provinces). Burmese birds on the other hand are definitely distinguishable from *nepalensis*. They lack the bluish wash on the sides of the head and nape and the mandibular stripe is most markedly narrower; whilst their larger size and narrower mandibular stripe equally separates them from the typical race. The difference between the Sikkim-Duars and Burmese birds was recognised by Hume in naming his *Palaeornis indoburmanicus* (S.F., vii, p. 459) but he expressly stated that further subdivision was unnecessary. How he came to consider the Sikkim-Duars birds separable from *nepalensis* is not clear to me. Accepting their identity there is no doubt that the name *indoburmanicus* must become a synonym for *nepalensis*. Reading the original description one has no difficulty in seeing that Hume primarily intended to apply it to the Sikkim bird with which he contrasts Burmese birds. This was recognised by Kloss [J.N.H.S. (Siam), vol. ii (1917), p. 219] who made the point clearer by restricting the type locality to Sikkim. He then proceeded to name Burmese birds *Palaeornis eupatria avensis* (type locality Bhamo) and this name will stand for them.]

Psittacula krameri manillensis (Bechstein).

Palaeornis manillensis Bechst., Stubenvögel (1794), p. 612—Africa and the Philippines *errore*—Ceylon.

Specimens collected:—518 ♂ 5-7-29 Kalai, Trichinopoly; 940-941 ♂ ♀ 30-10-29 Nallamallai range 2,000 ft.; 1129 ♂ 17-12-29 Cumbum Valley.

Measurements:—

	Bill from cere.	Wing.	Tail.	Tarsus.
3 ♂	22.5-23	171-172	243.5	16-17 mm.
1 ♀	22	155.5	185.5	17 mm.

There is curiously little information on record about the Green Parakeet in the Presidency though one suspects it to be common and generally spread.

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On the eastern side I have found no actual records of it except the above Survey specimens and Dewar's statement that it is common at Madras in the cold weather but less frequently seen in the hot weather. On the western side it is only actually recorded in the Palnis and Travancore. Of the Palnis Fairbank said that it is common round the base, sometimes ascending the hillsides. Terry found it on the slopes below Pulungi and in the Pittur Valley. In Travancore according to Ferguson it is very common throughout the low country, breeding in February and March.

It is curious that everyone appears to have overlooked the variation in size from north to south of this common species. Four males from the type locality Ceylon measure: bill (from cere) 22·5-23·5 mm., wing 156·5-165 mm., tail 197-225 mm. and I have no hesitation in keeping with the typical form the few specimens available from Travancore, Mysore and the Madras Presidency up to the Cumbum Valley. Eleven males from this area, including the above Survey and Ceylon specimens, yield a range of bill (from cere) 22-24 mm., wing 156·5-172, tail 197-243·5 mm. Ten males from the Punjab, on the other hand, measure: bill (from cere) 23·5-26·5 mm., wing 175-186·5 (once 190·5) mm., tail (once 189) 225-263 mm. This marked difference cannot be overlooked even though the advance in size throughout the Peninsula is gradual as in other species. There is no sharply defined boundary between the races, therefore, but for convenience it may be fixed arbitrarily at the 20° latitude. Northern birds also average very slightly paler and yellower in colour. On the other hand I am unable to agree with the separation of Assamese from North Indian birds on the colour of the lower mandible. This is a feature which is rather hard to assess as roughly 50 per cent of specimens throughout India and Assam have the lower mandible parti-coloured so that one is at a loss whether to consider it black or red. Examination of a number of specimens however gives the following figures:—

Locality.	Lower mandible red.	Intermediate.	Lower mandible black.
Punjab, Sind	6	6	2
Assam	9	8	2
S. India & Ceylon	—	6	8

These figures show clearly that, while the black lower mandible is of service as a racial distinction in the smaller southern race, it is no distinction as between the larger northern birds and birds from Assam. They are alike in colour and size, unless Assamese birds average slightly more blue in tint. The difference, if it exists, is not however marked enough to warrant racial separation.

Psittacula krameri borealis Neumann, Orn. Monatsb., vol. xxii (1915), p. 178—Assam, should therefore include the large North Indian birds.

Psittacula cyanocephala cyanocephala (Linnaeus).

Psittacus cyanocephalus Linnaeus, Syst. Nat., i (1766), p. 141—India Orientale, now restricted to Gingee, S. Arcot.

Specimens collected:—4 ♂ 9-4-29 Kurumbapatti; 783 ♂ 1-9-29 Kodur; 1553 ♂ 16-3-30 Sankrametta 3,000 ft.

Measurements:—

	Bill from cere.	Wing.	Tail.	Tarsus.
3 ♂	16-18	133-138	177-222	11-13 mm.

The Blossom-headed Parakeet is probably very generally spread in the Presidency as a resident species. On the eastern side it is common in the Northern Circars and the Carnatic according to Jerdon and in addition to the three Survey localities we know that it occurs at Madras, where Dewar states it is not so common as the Common Green Parakeet.

On the West it is extremely common in Coorg (Betts). William Davison says that it is not uncommon in the Wynaad and at the base of the hills, ascending the Nilgiris to about 3,500 ft. I have seen specimens from Cannanore (♂ 9-10-82 Wardlaw-Ramsay), Calicut (♂ 9-3-83 Wardlaw-Ramsay) and Malappuram (♂ 2-7-12 Sparrow Collection).

On the Palnis it is common at Pulungi and other localities on the slopes up to 4,000 ft. In Travancore, Ferguson says that it is common in the low

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country, wherever there is forest and also about the foot of the hills, which however it does not ascend.

Betts says that the nesting season begins in Coorg at the beginning of January and Ferguson gives March for Travancore.

As in the case of the last species this Parakeet must be divided into a northern and southern race in the Peninsula on the question of size, though there is of course the usual intergrading between them. Twenty males from Ceylon, Travancore, Kurumbapatti, Wynaad and the Nilgiris measure:—wings 131-143 mm., tail 171-222 mm. Seventeen males from Northern India (Punjab, United Provinces, Orissa, Bengal) measure:—wings 137·5-151·5 mm., tail 172-234 mm. As names already exist applicable to these areas the two races may be recognised and the boundary between them may be taken as the 20th degree of latitude.

Only two races are recognised in the *New Fauna*, the Eastern and the Western—the latter including our North Indian and South Indian—both of which were considered as species in the *Old Fauna*. Considerable dispute has from time to time taken place over the correct names for these birds and it is desirable to settle the question. The evidence to go upon is not very good but nevertheless sufficient we think to prove our case.

The differences between the Eastern and Western birds are in the colour of the head—a difference not very easily shown in a coloured plate—and in the colour of the under wing-coverts. This last cannot of course be seen in a picture and it is not mentioned in any of the descriptions.

To begin with the oldest name is *Psittacus cyanocephalus* Linnaeus, Syst. Nat., i, p. 141, 1766, based on the description and uncoloured plate in Brisson's *La Perruche à tête Bleue* (Ornithologie, iv, p. 359, pl. xix, fig. 2, 1760). This bird was a female in the collection of Abbé Aubray and was said to have come from Inde Orientale—a vague term in those days for anywhere east of Suez. This Abbé Aubray apparently had a considerable collection, from all parts of the world, since Brisson frequently refers to it in his volumes, but after a search we can only discover two species which are definitely said to have come from India. These are *La Perruche à tête rouge de Gingi* (vol. iv, p. 346, pl. xxix, fig. 2) and *La Perruche de Gingi* (vol. iv, p. 343, pl. xxix, fig. 1). The first is a synonym of *Psittacus cyanocephalus*—a male—and the second the origin of *Psittacus eupatria* Linnaeus. Since both the birds came from Gingi we may fairly well assume that *La Perruche à tête Bleue* also came from the same locality and the name *cyanocephalus* will stand for the South Indian race. For the North Indian bird *Psittacus bengalensis* Forster Indische Zoologie, 1781, p. 40, is available and is founded on Brisson's plate and description (Ornithologie, iv, p. 348, 1781) of *La Perruche de Bengale*. But Brisson never saw the bird himself and copied his description from Edward's plate and description of the Rose-headed Ring Parakeet (History of Birds, vol. v, p. 47, pl. 233) and Albin, History of Birds, vol. iii, p. 14, pl. 14, of a bird sent home from Bengal—almost certainly Calcutta[1]—to which place the type locality may be restricted. To the Eastern race we may restrict the name *rosea* of Boddaert, Table Pl. Enlum., p. 53, 1783, which was given to the plate and description of the *Perruche de Mahé* in Daubenton's Planche Enl., vol. vii, pl. 41.

In the letterpress Daubenton makes no mention of any locality but says his bird is similar to Edward's Rose-headed Ring Parakeet. On the plate however it is given as *de Mahé*.

The colour of the head of the bird on this plate is too light for any Blossom-headed Parakeet from Western India and probably came from somewhere east of Calcutta; we restrict the type locality to Chittagong.

Psittacula columboides (Vigors).

Palaeornis columboides Vigors, Zool. Jour., vol. v, pt. xviii (June 1830), p. 274, no locality—restricted to Aneichardi, Travancore.[2]

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[1] We are very grateful to Dr. Baini Prashad, Director of the Indian Museum, for specially procuring us topotypes of this Parakeet from the neighbourhood of Calcutta to enable us to verify the correctness of this restriction.

[2] Stuart Baker, *J.B.N.H.S.*, xxviii, p. 160.

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Not met by the Survey, as in the Presidency it is confined to the western side. Betts reports that it is common in Coorg. William Davison states that it occurs throughout the Wynaad and the Nilgiris. It is perhaps most numerous on the slopes up to about 5,000 ft. but occasionally ascends to the plateau and the good series in the British Museum contains specimens from Ootacamund.

According to Kinloch, this is the only species of Parakeet in the Nelliampathies. Fairbank found it common on the Lower Palnis and along the hillsides and Terry records it from the slopes below Pulungi.

In Travancore it is confined to the hills, not ascending about 3,000 ft. in the south but found at 5,000 ft. in the High Range.

According to Betts, the breeding season of the Blue-winged Parakeet starts in Coorg in January. In Travancore, Bourdillon considered the breeding season to last from 1st January to the end of March and most eggs appear to have been taken in January and February (see Hume's Nests & Eggs, vol. iii, p. 89 and Stuart Baker, *Nidification*, vol. iii, p. 381).

This beautiful bird occurs along the Western Ghats as far north as Khandala. In its limited range it exhibits the slight increase in size from South to North common to many species with a similar distribution, but the increase is too slight and the range too limited for any useful purpose to be served by an attempt to recognise two subspecies.

Coryllis vernalis rubropygius Stuart Baker.

Coryllis vernalis rubropygius Stuart Baker, Bull. B.O.C., vol. xlvii (1926), p. 44—Belgaum.

Specimens collected:—1329 ♂ 6-3-1930, 1777 ♂ 5-5-1930 Anantagiri 3,000 ft.

Measurements:—

	Bill from cere.	Wing.	Tail.	Tarsus.
2 ♂	12-12·5	92-96·5	42-42·5	10-10·5 mm.

The Survey found the Indian Lorikeet common at Anantagiri when the Silk-Cotton tree was in bloom, and Mr. La Personne considered that it was probably breeding in April. He also found it at Sankrametta at 3,000 ft., but there it was not common.

This is another of the interesting discoveries made by the Survey as hitherto this species was not known to occur anywhere between the Himalayas and Assam and South-West India. In the latter area it is of course common and well-known.

In Coorg it is very common (Betts). William Davison found it generally distributed throughout the Wynaad and remarks that in some parts, especially along the old avenues of Jack trees about Manantoddy, it was quite common. It ascends the slopes of the Nilgiris to about 6,000 ft. Jerdon remarks how intoxicated birds were taken at Tellicherry, this little bird often imbibing too freely from the juice of the Toddy tree.

Kinloch considered the Lorikeet common in the Nelliampathies. Fairbank noted it several times at the eastern base of the Palnis and Terry met several in the Pittur Valley. In Travancore, Ferguson says that it is common on the hills and he describes a nest with 3 hard-set eggs found at 2,000 ft. by Bourdillon. This was on 15 March, and another with 3 eggs was found by Stewart on 6 January (Stuart Baker, *Nidification*, iii, 386).

It is with considerable hesitation that I have kept up the race *rubropygius*, which, if separable, differs from the typical race solely in the duller more saturated red of the rump patch as compared with the vivid red of this patch in Assamese birds.[1] In my experience this distinction only holds good for a limited number of specimens, and I am not sure how much it depends on individual variation, wear or age. The two Anantagiri specimens, for instance, vary greatly in the colour of their rumps, one agreeing with the northern, the other with the southern race, and it is probable that a larger series would merit inclusion in the typical race. I am also very doubtful as to the correctness of the present grouping of these small Lorikeets into species and sub-

[1] In vol. vii, p. 343 of the *New Fauna*, Stuart Baker has omitted his restriction of the type locality to Cachar (J.B.N.H.S., xxviii, 161).

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species and suspect that ultimately *vernalis* will prove to be a race of *Coryllis beryllinus* of Ceylon. A decision of this point should however only be made after a full study of the whole group to ascertain the respective extent of its specific and subspecific characters.

Coracias benghalensis indica Linnaeus.

Coracias indica Linnaeus, Syst. Nat., ed. xii, vol. i (1766), p. 159—Ceylon.

Specimens collected:—373 ♂ 9-6-29, 388 ♂ juv. 12-6-29, 405 ♂ 14-6-29 Chitteri range 2,000-3,000 ft.; 532 ♀ 7-7-29 Kalai; 602 ♀ 24-5-29 Gingee; 1152 ♀ 21-12-29, 1179 ♀ 27-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	40-42	174-184·5	120-123	25-26 mm.
4 ♀	40-42·5	177-186	119-125	25-26 mm.

As in the case of many other common and doubtless generally distributed species, I am unable to find any actual record of the Indian Roller or Blue-Jay in the Presidency north of the River Godavery. Southwards it occurs in some numbers though not apparently quite so numerously as in Northern India. La Personne found it plentiful and breeding everywhere in June in the Chitteri Range at 3,000 ft., occurring also in the Shevaroys up to 4,000 ft.

On the West it is much less common. In Coorg, Betts says that it is an occasional visitor in the dry season, never staying very long. While it occurs in the Wynaad and about the base of the Nilgiris it is not abundant and does not ascend the latter. In the Palnis, it seems to be confined mostly to the eastern base and Terry records it in the Pittur Valley. In Travancore also it is said by Ferguson to be confined to the low country, being common only towards Cape Comorin. Elwes however met it in the Cardamum Hills (*Ibis* 1870, p. 526).

Nothing is recorded about the breeding season in the Presidency.

In the *New Fauna* (iv, pp. 224-226) Stuart Baker confines this race of the Blue-Jay to Ceylon and South Travancore, stating that it differs from the typical race both in size and colour. The difference in colour I am not, however, able to confirm, and as regards size I find that the Blue-Jay agrees with so many other species in showing a gradual increase in size from south to north. The available series from Ceylon is a poor one, seven specimens in the British Museum and these not all sexed. They measure:—bill 37-47 mm., wing 171-184 mm., tail 116-128 mm. Fourteen birds from the Presidency, including the Survey series, and Bangalore measure:—bill 39-49 mm., wing 171.5-186 mm., tail 109-125 mm. These are clearly not separable from the Ceylon series and birds from Hyderabad, Kanara, Belgaum and Ahmednagar are certainly nearer to these than to the large northern race of which I measure a series of thirteen specimens (Punjab):—bill 42-49 mm., wing 183.5-201 mm., tail 128.5-139.5 mm. The line of division between the two races must necessarily be arbitrary and it may most conveniently be fixed along the 20th degree of latitude.

Eurystomus orientalis (Linnaeus).

Coracias orientalis Linnaeus, Syst. Nat., ed. xii (1766), vol. i, p. 159—India.

The Broad-billed Roller is not known to occur on the eastern side of the Presidency and it was not observed by the Survey. On the West it appears to be fairly general but scarce. William Davison says that he once met with it in the Wynaad. Vipan (S.F., i, 495) says that he saw several in August 1872 in the Malabar jungles near the foot of the Carcoor Ghat of the Nilgiris, and this was apparently at Nellumbore where R. W. Morgan also obtained several specimens and procured the eggs (S.F., ii, 532). William Davison says that he had sometimes seen it on the Coonoor Ghat.

Kinloch found it breeding in the Nelliampathies, a pair with young in March.

In Travancore it seems to be better known, though there is some doubt about its actual status. F. W. Bourdillon (S.F., iv, 382) says: 'This bird,

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nowhere abundant, is, I think, only a visitor, although I have observed it in August, during the winter months, in April and as late as May'. This is amplified by T. F. Bourdillon (N. & E., iii, 58):—'They come to us about the beginning of August and leave towards the end of April, after breeding. They are not very common but almost every estate has its pair which generally are to be found at about 1,000-2,000 ft. above sea-level. This he again expands (J.B.N.H.S., xv, 658):—'Comes to us to breed, leaving Travancore again before the commencement of the monsoon. Pairs of these birds may be seen here and there throughout the length of the hills at elevations from 500-3,000 ft., any time between September and the end of April; but they are by no means common.' Ferguson says that it is eminently a forest species but he only procured a single specimen. I find it hard to believe that the bird is not a resident.

F. W. Bourdillon took 3 eggs on the 17th March. T. F. Bourdillon found an occupied nest on 20th April and in *Nidification* (iii, 392) Stuart Baker gives the breeding season in Travancore variously as September to May and March to May on the authority of the Bourdillons.

Sharpe described these South-West Indian Rollers as a separate form *Eurystomus lætior* P.Z.S. 1890 (October), p. 551—Malabar, but the *New Fauna* attributes them to the typical race. I have seen too poor a series of Indian specimens to decide between these conflicting opinions.

Merops orientalis orientalis Latham.

Merops orientalis Latham, Suppl., Index Orn. (1801), p. xxxiii—Mahratta, India.

Specimens collected:—173 ♀ 2-5-29 Kurumbapatti; 292-3 ♂ juv., ♀ 30-5-29, 421 ♂ 15-6-29 Chitteri Range 2,000-3,000 ft.; 515-6 ♂ ♀ 5-7-29 Kalai; 664 sex? 8-8-29 Palkonda Hills 1,000 ft.; 781 ♂ 1-9-29, 785 ♂ 2-9-29 Kodur 500 ft.; 912 ♀ 13-10-29 Seschachalam Hills 2,000 ft.; 1035 ♀ 25-11-29 Nallamallai Range 2,500 ft.; 1058-60 ♂♂♂ 8-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
7 ♂	31-33	92-98·5	119-129·5	9-10 mm.
5 ♀	31-33·5	92-94	109-126·5	8-10 mm.

The Little Green Bee-eater does not appear to have been actually recorded in the northern part of the Presidency down to the Godavery, but it doubtless occurs in this area as plentifully as elsewhere. Southwards it appears to be very generally and plentifully distributed presumably as a more or less resident bird though it is true that Dewar seems to have some doubt whether it bred about Madras City or not (J.B.N.H.S., xv, 492; xvii, 522).

On the West, Ferguson considered it one of the commonest birds in the low country in Travancore. Fairbank found it plentiful at the base of the Palnis and in the adjacent plains, Terry mentioning it in the Pittur Valley. William Davison tells us that it is common on the slopes of the Nilgiris up to 5,500 ft., occurring also up to 6,000 ft.; it is also common about the foot of the hills and in the Wynaad. Here it seems to be a resident, breeding in the Nilgiris in March and April. In Coorg, on the other hand, Betts (J.B.N.H.S., xxxiii, 548) says that it is exceedingly common as a winter visitor, arriving in October (10 October, 1928) and leaving at the beginning of March (7 March, 1929). In 1932 he first saw it on September 12 (J.B.N.H.S., xxxvii, 225). This corresponds well with Taylor's experience at Manzeerabad, Mysore (S.F., x, 456) that the birds arrived in the middle of September, leaving again in June, with John Davidson's experience in Kanara that it was absent in the rains (J.B.N.H.S., xii, 43), and Benjamin Aitken's account (N. & E., 2nd ed., iii, 61) that it leaves Bombay from April to September.

Merops orientalis orientalis occupies the rather unsatisfactory position of an intermediate race between the pale, clear-coloured green of *M. o. biludschicus* with little golden sheen on the crown and the more opaque green of *M. o. birmanus* which has a very definite ferruginous-golden sheen on the crown and hind part. These two extreme races when contrasted with each other are very distinct, and *orientalis* and *birmanus* are as a rule sufficiently recognisable *inter se*. The difference between *biludschicus* and *orientalis* on the other

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hand is poorly defined and can only be recognised on series of which the locality is known. The blue on the throat is a variable feature of no racial significance in the three Indo-Burmese races. The few Travancore specimens that I have seen approximate, as might be expected, towards the richer colour of *birmanus* but it is unnecessary to do more than note the point, as *orientalis orientalis* varies a good deal in depth of colouration throughout its whole range.

Merops superciliosus javanicus Horsfield.

Merops javanicus Horsf., Trans. Linn. Soc., vol. xiii, pt. i (May 1821), p. 171—Java.

Specimens collected:—1142 ♂ 19-12-29, 1143 ♂ 21-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	45	133-138	139-5-141	11-13 mm.

The Blue-tailed Bee-eater appears to be widely distributed in the Presidency. Ball met it at Jeypore in April (S.F., v, 413). Colonel Sparrow obtained a specimen, now in his collection, at the Kolair Lake on February 1st. The Survey obtained two specimens in December in the Cumbum Valley. In the neighbourhood of Madras, according to Dewar, it is very common in the paddy fields in the cold weather. Jerdon tells us—with his usual irritating indifference to dates—that on one occasion he saw an immense flock, probably many thousands at Caroor (Karur) on the road from Trichinopoly to the Nilgiris.

On the western side a specimen from Calicut (♂ 4-4-83 Wardlaw-Ramsay) is in the British Museum. William Davison says that these Bee-eaters are very locally distributed and not numerous, always in small flocks which never stay more than a few days in any one locality. He goes on to say that he has seen them on the Coonoor Ghat, on the skirts of the Government Cinchona Plantations at Neddivattum, and in the Wynaad at the foot of the Brahmagherries. In the Nelliampathies, according to Kinloch, they are very common on the Northern slopes.

In the Palnis in October 1866 Fairbank found the Blue-tailed Bee-eater abundant by the town of Palni, near the north base of the hills. On his later visit he only observed it once, near Periur.

In Travancore Ferguson only knew of one specimen, shot near Trivandrum in August 1893.

Rhodes Morgan (*Ibis* 1870, p. 314) says that this species breeds in large numbers in the banks of the Kistna and Cauvery Rivers. I do not know if this record is reliable and there is no other record of the breeding of this Bee-eater in the Presidency. It is a winter visitor to Ceylon and its movements in most localities are difficult to understand so I will not attempt to define its status.

To prevent further confusion I may note that the young Bee-eater obtained at Pundharpur in October (S.F., vii, 77) was *persicus*. In the *New Fauna*, vol. iv, p. 233, it masquerades as *apiaster* while in the *Journal, Bombay Natural History Society*, xxxvii, it has become *javanicus*.

Merops leschenaulti leschenaulti Vieillot.[1]

Merops leschenaulti Vieillot, Nouv. Dict., vol. xiv (1817), p. 17—Ceylon.

No specimen of the Chestnut-headed Bee-eater was obtained by the Survey but La Personne states that a single specimen was seen at Kurumbapatti after a heavy shower of rain. He considered it had probably come down from the Shevaroys from which hills there is a specimen in the Madras Museum. No one else has recorded it on this side of the Presidency except Rhodes

[1] For genus see Ticehurst, *J.B.N.H.S.*, xxxiv, 471 and xxxvi, 934.

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Morgan who states that it breeds in large numbers on the banks of the Kistna and the Cauvery (*Ibis* 1870, p. 314).

On the western side it is far better known though its movements seem rather erratic and difficult to understand. In Coorg Mr. Betts considered it a passage migrant as it was extremely common in large flocks in June 1928. It disappeared entirely at the end of the month and was not again observed save for a flock on September 24th. It is not uncommon in the Wynaad.

In the Nilgiris it is common up to about 4,500 ft. and occurs certainly up to 5,500 ft. though it does not ascend to the plateau. Here it breeds in March and April (W. Davison) and Mr. Betts informs me that it leaves the western side (at any rate) of the hills in June, returning about November.

In the Nelliampathies it is common on the northern slopes (Kinloch). In the Palnis Fairbank found it common on the eastern side of the hills at 2,000-3,000 ft. on his first visit in 1866 but on a subsequent trip only saw it once. Terry saw several in the Pittur Valley.

In Travancore, Ferguson says it is confined to the hills where it is not uncommon in North Travancore about Pirmerd and the High Range. Here he says it breeds in February.

All Indian specimens are quite inseparable in colour from Ceylon birds. The few Ceylon specimens that I have seen, however, appear to have shorter bills than Peninsula specimens; but a proper series may prove that this is incorrect.

The name of this bird has long been a cause of dispute amongst ornithologists. Many years ago both Hume and Lord Tweeddale pointed out that *Merops erythrocephalus* Gmelin, Syst. Nat., i, p. 433 (1778), based on Leguépier à tête rouge des Indes of Brisson Aves, vol. iv, p. 563, pl. 44, fig. 3 (1760) could not be used. Unfortunately however in 1919 Stuart Baker, Jour., Siam Nat. Hist. Soc., vol. iii, p. 432, saw fit to revert to its use, since he said Brisson's description and figure were quite recognisable. Brisson's figure was uncoloured, but Shaw and Nodder, Nat. Misc., pl. 357 (1778), gave an exact copy which they coloured from the description. Neither in this coloured plate nor in Brisson's description is there any sign or mention of the black line across the breast, nor the turquoise blue of the rump. From the position the bird is drawn in this last colour should be very evident. Shaw's figure shows a bird with a chestnut head, green back, tail and wings and yellowish-white below and does not represent, as far as we know, the colour of any known Bee-eater.

The next name which must be considered is *Merops leschenaulti* Vieillot, Nouv. Dict., vol. xiv, p. 17, 1817, based on Le Vaillant's *Le guépier laichenot*, pl. 18, p. 55 in Hist. Nat. Des Promerops (1806). The figure and description agree except in one particular viz., the throat which is described as follows: 'La gorge est couverte d'une plaque triangulaire, d'un roux jaunâtre, laquelle se termine par un collier étroit gris-vert, qui, dans l'ombre, semble noirâtre', whereas in the plate it is pale yellow. The figure is that of a young bird of the Ceylon-Indo-Malayan race, with some greenish feathers on the head, black line passing from the base of the bill to several millimetres beyond the eye, and a not very distinct black line across the throat. The green feathers on the crown and the indistinct breast line are both signs of immaturity.

The bird is said to come from Java but it certainly never did, and there is in the British Museum Collection a young specimen from Assam which agrees with the picture very closely.

The name therefore for the typical race will have to be *Merops leschenaulti leschenaulti* Vieillot, Nouv. Dict., vol. xiv, p. 18, 1817, and the type locality Ceylon.

For the Javan race the name *Merops quinticolor* Vieillot, Nouv. Dict., vol. xiv, p. 21, 1817, is available. The description is taken from Le Vaillant's *Le guépier quinticolor* Hist. Nat. Des Promerops, pl. 51, p. 15, 1906, which is said to come from Ceylon. The figure and description however are clearly that of a bird with a narrow black band across the breast, the black line not passing beyond the eye, the characters of the Javan race. Exception may be taken to the blue feathers in the wing-coverts of the figure, but these are not uncommonly seen in this species and probably may be accounted for by the fact that the feathers are worn. This race will therefore stand as *Merops leschenaulti quinticolor* Vieillot, Nouv. Dict., vol. xiv, p. 21, 1817. Type locality Java.

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From the descriptions and figures it appears quite evident that Le Vaillant had mixed his localities as Oates many years ago pointed out in Birds of Burma, vol. ii, p. 68, 1883.

Alcemerops athertoni (Jardine & Selby).

Merops athertoni Jardine & Selby, Illustr. Orn., vol. ii (1828), pl. 58—India; Bangalore (see Ibis 1925, p. 751).

Specimens collected:—290 ♀ 30-5-29, 299 ♀ 31-5-29 Chitteri Range 2,000 ft.; 1416-17 ♂ ♀ 20-2-30, 1441 ♀ 25-2-30 Anantagiri 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	51	137	131	17 mm.
4 ♀	43·5-49	128·5-142	117-141	15-17 mm.

Mr. La Personne reports that the Blue-bearded Bee-eaters were spread over a wide area in the Vizagapatam district and that they were very partial to the Silk-Cotton trees from which they made sallies after insects. They were also met in the Shevaroys and in the Chitteri Range where they appeared to be uncommon and low level birds, haunting very dense forests. The only other record on this side is by Jerdon (B. of I., i, 212) who says that on one occasion he met the species on the Nackenary Pass leading from the Carnatic into Mysore at about 1,400 ft.

In the western side of the Presidency it occurs in Coorg for Mr. Betts told me (*in epist.*) that a small party were living on the borders of some paddy fields just below his bungalow. Both Jerdon and William Davison noted it in the Wynaad and on the slopes of the Nilgiris, the former up to 3,000 ft., the latter up to about 5,000 ft. A male from Sigur (10. vi. 67) and three birds from Kullar (October-November 1867) are in the Hume Collection. Col. H. R. Baker (Birds of Southern India, p. 174) states that he procured one specimen only on the Sigur Ghat at 4,000 ft., and this specimen is now in my collection.

Fairbank says (S.F., v, 394) that in December 1866 he obtained it at the head of the Kambam Valley which skirts the Palnis along their south-eastern base, besides observing a pair at Periur on the Lower Palnis in March. On the subsequent visit however he was unable to find it at all. Terry does not give it in his Palni list, and all that Ferguson knew about it in Travancore was derived from the labels of some old specimens in the Museum at Trivandrum. The Blue-bearded Bee-eater is presumably a resident in the Presidency but nothing is recorded about the breeding season, except that one of the February females from Anantagiri had the organs enlarged. This species has no races.

Ceryle rudis leucomelanura Reichenbach.

Ceryle leucomelanura Reichenbach, Handb. Alced. (1851), p. 21—Ceylon.

Specimens collected:—788-89 ♀ ♀ 3-9-29, 797 ♂ 799 ♂ 10-9-29 Kodur; 1219 ♀ 10-1-30 Godavery Delta.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	66·5-67	136-138	66·5-68	8·5-10·5 mm.
3 ♀	69-70	139-140	65-71	10-10·5 mm.

The Pied Kingfisher is not yet recorded in the Presidency north of the Godavery Delta, over the whole of which La Personne reports it to be common, extending also up the river. In Cuddapah he saw it at suitable waters all over the district. About Madras, Dewar reports it as very common. On the eastern side of the Presidency right across to the foot of the Nilgiris and the eastern base of the Palni Hills it is doubtless far more generally distributed on suitable waters than these records illustrate. Nothing has been recorded about the breeding season in this area.

On the western side the Pied Kingfisher is common in Coorg on the Cauvery and other big streams (Betts). Hume believed (S.F., x, 352) that it occurred

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in the Wynaad. A specimen from Calicut (Tweeddale Collection) is in the British Museum. In Travancore it is common along the backwaters.

I have seen no specimens from Coorg or the Wynaad, but Travancore specimens as well as the above Calicut bird are clearly separable from Indian birds generally and must be considered as furnishing another example of the local Travancore races. They are much darker looking birds giving a general impression of black spotted with white on the upper parts, whereas in Indian birds the general impression is white spotted with black. Not only is the actual extent of the white markings much smaller but they are a less pure white, sometimes almost smoky grey in tint. The black spotting on the flanks also tends to be more extensive. The series from Ceylon in the British Museum is not very good but it is sufficient to show that *leucomelanura* is the pale form, agreeing with Indian birds generally. I therefore propose for the above Travancore race the name

CERYLE RUDIS TRAVANCOREENSIS Subsp. nov.

Type:—Travancore (Surgeon-General Fry), British Museum Reg. No. 1910. 5.11.34.

Alcedo atthis taprobana Kleinschmidt.

Alcedo ispida var. *taprobana* Kleinschmidt, Orn. Monatsb., vol. ii (1894), p. 126—Ceylon.

Specimens collected:—780 ♀ 1-9-29, 798 ♂ 10-9-29 Kodur; 1096 imm. 13-12-29 Cumbum Valley.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
♂	43·5	72	33	8·5 mm.
♀	45	72·5	32	8 mm.

With the exception of Dewar's statement that the Common Kingfisher is very numerous at Madras, the above specimens provide the only definite records for the eastern side of the Presidency, though it is probably more common and more generally distributed than this fact would lead one to believe.

On the western side it is common in Coorg, the Wynaad and the Nilgiris and I possess a specimen from the Palghat gap. In the Nelliampathies, Kinloch considered it very rare, found only on perennial streams on the plateau. Fairbank did not meet with it in the Palnis, but Terry observed a pair near the Goondar stream in the Pittur Valley. In Travancore it is common about the backwaters everywhere and also about tanks and ponds in the low country, though it does not ascend the hills.

Ferguson's statement that the Kingfisher breeds in March in Travancore appears to be the only information about the breeding season in the Presidency.

All the specimens which I have examined from the Presidency, south of the Godavery River, most certainly belong to the very blue Cinghalese race and not to *Alcedo a. bengalensis*.

Alcedo meninting subsp.?

Alcedo meninting Horsfield, Trans. Linn. Soc., vol. xiii (1821), p. 172—Java.

Beavan's Kingfisher was not procured by the Survey and it appears to be very local in the Presidency. William Davison (S.F., x, 351) thought that he recognised one on the banks of a small stream between Goodalore and Nellacotta in the Wynaad. Bourdillon and Ferguson considered it not uncommon in Travancore where it is confined to the small patches of paddy cultivation and the streams which irrigate them about the base of the hills. A specimen from the Mynall Estate (Bourdillon) is in the British Museum, as is also a male collected by Theobald on 18 October 1868 at Pothanore in Salem district. Nothing is known as to the status of Beavan's Kingfisher in the Presidency but it is presumably a resident, as Stuart Baker records eggs taken by Stewart in Travancore at 2,000 ft. on 17th January (*New Fauna*, iv, 255; *Nidification*, iv, p. 409).

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There is a good deal of difficulty over the identification of the form of Beavan's Kingfisher which occurs in the Presidency. Mr. Stuart Baker is of opinion that two forms occur (*New Fauna*, iv, pp. 255-56) namely his Ceylon race *phillipsi* to which he attributes the Pothanore bird and the Mynall bird and *A. m. asiatica* which he considers occurs from the rest of Travancore northwards to Belgaum.

I have unfortunately been unable to inspect the Tring collection and the series of 9 birds from Ceylon on which Mr. Stuart Baker bases his race *phillipsi*. There is only one specimen from Ceylon in the British Museum. I have therefore been unable to complete my examination of this group, which does however suggest to me that the number of races recognised in the *New Fauna* are too many. Of the two Presidency specimens mentioned above the Mynall bird agrees well enough with the single Ceylon specimen examined. The Pothanore bird on the other hand is quite different, being a deeper blue in colour, agreeing far better with the Javan form. For the present therefore I do not feel justified in attributing Presidency birds to any particular race.

[Ceyx erithaca (Linnaeus).

Alcedo erithaca Linnaeus, Syst. Nat., ed. x (1758), p. 115—Bengal.

The Three-toed Kingfisher is included by Inglis and Baker in their Birds of Southern India without comment and presumably on the authority of the *New Fauna* (iv, 260) where it is said to occur in 'Ceylon, Travancore and the Malabar Coast to Kanara'. It is of course well known in Ceylon, but I can find no original record of it from the Presidency beyond Jerdon's statement (B. of I., i, 230) that he obtained it in Southern India. Elsewhere he speaks of this as in the Carnatic. As this species is only authentically recorded from one area in India, namely the Sahyadris towards Bombay (Matheran and Khandala, Kinnear, J.B.N.H.S., xix, 749; Butler, S.F., ii, 455; v, 503; between Ambolee and Danowlee, Butler, S.F., ix, 383), I think further evidence is required for its full inclusion in the Presidency list.]

Ramphalcyon capensis gurial (Pearson).

Halcyon gurial Pearson, J.A.S.B., vol. x (1841 after 11 August), p. 635—Calcutta, Midnapore.

The Brown-headed Stork-billed Kingfisher was not reported by the Survey, and the only record of it in the eastern side of the Presidency appears to be Jerdon's statement (B. of I., i, 223) that it is occasionally found in the Northern Circars and is rarely seen in the Carnatic.

On the western side William Davison tells us that he saw it on some of the larger streams in the Wynaad, though only occasionally. Fairbank saw it twice at the eastern base of the Palni Hills. Ferguson says that in Travancore it is confined to the low country about the foot of the hills, being nowhere abundant.

Nothing is known about the breeding season in the Presidency except that in Travancore Stewart and Bourdillon found eggs in February and March, and Bourdillon also obtained 4 fresh eggs on 20 July (Stuart Baker, *Nidification*, iii, p. 416).

There seems to be only the one race of this species in India proper.

Halcyon smyrnensis smyrnensis (Linnaeus).

Alcedo smyrnensis Linnaeus, Syst. Nat., ed. x, vol. i (1758), p. 116—Smyrna.

Specimens collected:—468 ♂ juv. 23-6-29 Tirthamalai 1,000 ft.; 841 ♀ 20-9-29 Kodur; 978 ♂ 7-11-29 Nallamalai Range 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
♂	60	114	76	14 mm.
♀	58·5	119	79	14 mm.

The Survey has provided us with surprisingly little information about the status of the White-breasted Kingfisher in the Presidency and there is no

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record of it anywhere north of the Nallamalai Range and Kodur in both of which places single specimens were preserved. In South Cuddapah, Mr. La Personne remarks that it was found frequently in dense forest far from any water, feeding apparently on grasshoppers. About Madras, Dewar found it most abundant, occurring in almost every garden. Southwards, La Personne saw it in the low country around Harur and secured the above specimen at Tirthamalai. Nothing is recorded about the breeding season.

The Survey specimens cannot be distinguished from north-western birds in colour though they appear to be smaller. 8 Punjab specimens measure:—bill from skull 59-66 mm., wing 122-129 mm., tail 75-87 mm. These figures suggest the existence of a northern and a southern race, depending on size, but before recognising it one would require to see more birds from the Presidency.

Apart from this detail, I disagree with Stuart Baker's treatment of this species. He confines the typical race in India to the north-west, viz., Baluchistan, Sind, Punjab and Kashmir, separates birds from Ceylon and the extreme south of Travancore as *Halcyon s. generosa* Madarasz, and attributes birds from the whole of the rest of India, Burma and farther east to an intermediate race *H. s. fusca*.

This is unsatisfactory. It is quite impossible to distinguish Ceylon birds from those found along the western side of the Presidency in the rain area from Coorg to the south of Travancore. They differ neither in size nor in the rich darkness of the chocolate brown parts of the plumage (I can see no difference in the colour of the back of this species anywhere in India; the tint of blue varies individually and is also affected by wear). For these birds the oldest name is *Alcedo fusca* Boddaert. The birds from the whole of the rest of India, including the north-west, appear to me to belong to one form in which the chocolate-brown is definitely paler, though individuals differ a little *inter se*. As stated above these will probably prove to be divisible on size into a northern and southern race.

Halcyon smyrnensis fusca (Boddaert).

Alcedo fusca Boddaert, Table Pl. Enlum. (1783), p. 54, based on Pl. Enlum., 894—Malabar.

If my views expressed above are correct, this race of the White-breasted Kingfisher is entirely confined to the west of the Presidency from Coorg to Cape Comorin. In Coorg according to Betts it is common and there is a specimen from here in the Tweeddale Collection in the British Museum.

A male obtained on 29-3-1881 by William Davison at Nellacotta is in the British Museum. He says (S.F., x, 351) that at the base of the Nilgiris, especially in the better-wooded parts it is not uncommon but that it is only a straggler to the tableland where he had shot it two or three times at Ootacamund.

Fairbank saw it at Periur in the Lower Palnis, and Terry saw one near the Goondar stream in the Pittur Valley.

In Travancore, according to Ferguson, it is the commonest Kingfisher. It appears however never to ascend to any height in the hills, being found in the small patches of paddy cultivation and on the banks of the larger streams. Bourdillon adds that it lays about the beginning of April.

Halcyon pileata Boddaert.

Alcedo pileata Boddaert, Tabl. Pl. Enlum. (1783), p. 41 based on Pl. Enlum., 673—China.

The Black-capped Kingfisher was not procured by the Survey, but it seems to be sparingly distributed round the coasts of the Presidency. Jerdon tells us (B. of I., i, 226) that he once personally shot a specimen at Tellicherry and also had seen others from the same locality. Ferguson had a specimen which was caught alive in a well near Trivandrum (J.B.N.H.S., xii, p. 203; xv, 659).

On the eastern side it must be well established in the Godavery Delta for Roscoe Allen records (J.B.N.H.S., xvi, pp. 373 and 511) that he shot one on 15 January, 1905, on the Naidupalem Creek, a tributary of the Upputeru River which flows into the sea between the Kistna and the Godavery. Another was seen next day near the Lutchmapuram Lock on the Upputeru River, and

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yet another on the Yelem drain near Cocanada on 13 February, 1905. It follows these rivers some distance inland as Blanford obtained a male near Dumagudiam in the Godavery Valley on 21 February, 1871. This specimen is now in the British Museum.

There appears to be no difference between Indian and Chinese specimens.

Entomothera coromanda coromanda (Latham).

Alcedo coromanda Latham, Index Orn., vol. i (1790), p. 252—Coromandel Coast.

The sole authority for the occurrence of this lovely species, the Ruddy Kingfisher, in the Presidency is the specimen in the Government Museum at Madras which was shot by the superintendent Mr. Edgar Thurston at Guduvancheri about 16 miles south of Madras.[1] It renders unnecessary, however, Blanford's refusal (*Old Fauna*, iii, 135) to accept Latham's name for this species and Oberholser's proposal to designate the type locality as Rangoon on the grounds that the Coromandel Coast must be a mistake.

[**Sauropatis chloris vidali** (Sharpe).

Halcyon vidali Sharpe, Cat. Birds B.M., vol. xvii (1892), p. 278—South Konkan.

The White-collared Kingfisher is included in their *Birds of South India* by Baker and Inglis on the authority of the *New Fauna*, vol. iv, p. 277, where its distribution is given as 'South-west Coast of India. Stewart and Bourdillon both record it from Travancore and it appears to inhabit the coastal region from Travancore to the Konkan.' This race was of course discovered by Vidal in the Ratnagiri district where he found two distinct colonies in the mangrove swamps at Kelsi and Ratnagiri (S.F., vii, 168; viii, 414; ix, 50). The bird was not however found in Kanara by James Davidson nor can I trace any original record of its occurrence anywhere southwards to Travancore. The old E.I.C.'s Museum contained a specimen said to be from Madras but this locality was discredited by Jerdon (B. of I., i, 228). Under the circumstances further evidence seems necessary before this species can be admitted to the Presidency list. I am also very doubtful whether this race can be maintained. Vidal's birds do not appear to differ in any way from the only other Indian specimens in the British Museum, namely four from the Sunderbunds in the Hume Collection and these are usually attributed to *S. c. armstrongi*.]

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[1] This specimen was recorded in the Administration Report of the Madras Government Museum for the year 1902-1903. Guduvancheri is in Chingleput District and the Kingfisher was shot in November.

(To be continued).

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REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY.

BY

THE LATE E. BLATTER, S.J., PH.D., F.L.S.

PART XXVI.

(*Continued from page 548 of this volume*).

CYPERACEAE

BY

THE LATE E. BLATTER, S.J., PH.D., F.L.S., and C. MCCANN, F.L.S.

(*With two plates*).

9. BULBOSTYLIS Kunth.

(*Stenophyllus* Rafin. Cke. ii, 886.)

Annual herbs; rhizome short or 0. Stems tufted, leafy only at the base. Leaves very narrow, rarely absent; sheaths usually finely hairy. Spikelets of few to many flowers, flattened in umbelled or congested corymbs, sometimes reduced to a solitary one. Glumes imbricate on all sides, 1-2 lowest empty, the uppermost few tabescent, the intermediate 2-sexual. Hypogynous bristles 0. Stamens 1-3, usually 2. Style 3-fid, deciduous, as long as the nut, with a small bulbiform base which remains as a minute button on the apex of the nut when the style falls off. Nut obovoid, 3-gonous, smooth, hardly stalked.

Species about 70.—Most warm regions.

Key

1. Spikelets in a capitate head	1. *B. barbata*.
2. Spikelets in a lax umbel or compound umbel. Stem glabrous below the inflorescence ...	2. *B. capillaris* var. *trifida*.
3. Spikelets in a contracted umbel or compound umbel. Stem pubescent below the inflorescence	3. *B. puberula*.

1. **Bulbostylis barbata** Kunth Enum. ii (1837) 208.—*Stenophyllus barbata* Th. Cooke in Fl. Bomb. Pres. ii, 887.—For synonyms see C. B. Clarke in Hook. f. vi, 651.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Nadiad Farm (Bhide !); Ahmedabad, very common (Saxton 1728 !, Cooper !).—*Deccan*: Karli (Woodrow ex Cooke).—*S. M. Country*: Badami (Herb. St. X. C. 3116 !, Woodrow or Cooke !, H.E.B.B. !); Badami Hills (Paranjpye !); Gokak (Shevdye !); Hubli, 2,000 ft., rainfall 30 in. (Sedgwick 4982 !).—*N. Kanara*: Karwar, common on sandy soil (Talbot 555 ! 1314 !, Sedgwick 6592 !, Bell 2700 !, Hallberg & McCann C145 !).

Flowering & fruiting: July 1917 (Karwar); July 12th, 1919 (Ahmedabad); August 10th, 1883 (Karwar); August 17th, 1909 (Gokak); August 30th, 1892 (Badami); September 1st, 1912 (Badami); September 27th, 1913 (Ahmedabad); October 1911 (Nadiad); October 1919 (Karwar); December 1918 (Hubli).

Field notes: A monsoon species. In the northern part of the Presidency it dies down soon after the monsoon, but may be found near water at later periods. A plant that prefers sandy soil.

Distribution: Throughout India.—Ceylon, warm regions.

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2. **Bulbostylis capillaris** Kunth var. **trifida** C. B. Clarke in Hook. f. F.B.I. vi, 652.—For synonyms see C. B. Clarke l.c.

Description: A densely tufted annual. Stems 5-30 cm. long, setaceous, at the top glabrous. Leaves half as long as the stems, setaceous; sheaths with long white hairs in the throat. Spikelets in a simple or compound lax umbel, all solitary, or in weak examples, only 3-1 to a stem; bracts setaceous, short. Spikelets usually 3 by 1.25 mm., about 12-flowered, but vary from 1.25 to 6 mm., from dark brown to pale brown. Glumes boat-shaped, ovate, hardly acute, nerveless, pubescent; keel pallid. Stamens usually 2; anthers narrow-oblong, muticous. Style as long as the nut, filiform, glabrous; branches 3, long. Nut 2/5 the length of the glume, trigonous, obovoid, truncate, pallid or pale brown, smooth, without vertical or transverse undulate lines, or the transverse undulations faintly indicated; outermost cells short oblong longitudinally; style-base persistent on the nut as a small depressed ovoid button.

Locality: *W. Ghats*: Khandala (Gammie 15424 !); Mahableshwar, summit of Sindola, 4,700 ft., rainfall 300 in. (Sedgwick 4844 !), hillsides (Sedgwick 4672 ! 4673 !); Panchgani (Blatter & Hallberg B1742 ! B1744 !); Purandhar Fort (Bhide !); Castle Rock (Bell 4289 !).—*S. M. Country*: Astoli, open ground in forest (Sedgwick 2554 !).—*N. Kanara*: Karwar (Hallberg & McCann C146 !).

Flowering & fruiting: July 1917 (Astoli); September 1918 (Castle Rock); September 7th, 1907 (Purandhar); September 20th, 1902 (Khandala); October 1919 (Karwar); October 1920 (Panchgani); November 1918 (Mahableshwar).

Distribution: Very common from the Himalaya, 8,500 ft., to Ceylon.—Warm regions of the Old World.

3. **Bulbostylis puberula** Kunth Enum. ii (1837) 213; C. B. Clarke in Hook. f. F.B.I. vi, 652.—*Ibidem* see synonyms.

Description: A densely tufted annual. Stems 5-30 cm. long, setaceous, at the top hairy. Leaves half as long as the stem, setaceous; sheaths with long white hairs in the throat. Spikelets in a simple or compound umbel very nearly contracted into a head; the pedicels of the solitary spikelets often only 1.25-2.5 mm. long; bracts long or short, setaceous. Spikelets 5 mm. long, 10-flowered, oblong, dark brown. Glumes boat-shaped, ovate, hardly acute, pubescent. Style 3-branched. Nut ⅓ the length of the glume, trigonous, obovoid, truncate, pallid, transversely marked by wavy lines; style-base persistent on the nut, small, ovoid, depressed, dark red.

Locality: *N. Kanara*: Karwar, on sandy soil (Talbot 1314 ! 1512 !); sandy fields by the sea (Sedgwick 5089 !, Bell 2699 !).

Flowering & fruiting: July 1917, August 10th, 1885, October 1st, 1885, December 1918 (Karwar).

Distribution: N. Kanara, near the coasts of Madras Pres., Travancore, Malay Peninsula.—Ceylon, tropical Africa, Mascarene Islands, Malaya, Cochin China.

10. Scirpus Linn. Cke. ii, 890.

Species 200.—Cosmopolitan, characteristic of wet moors, bogs and marshes. Cooke describes 11 species from the Presidency. Of these we have united *S. Kysoor* with *S. grossus*, and *S. Michelianus* with *Juncellus pygmaeus*. Four species new to the Presidency have been added: *S. holoschoenus*, *S. erectus*, *S. mucronatus*, and *S. triqueter*.

Key

A. Large or middle sized. Stems leafy only near the base. Spikelets in clusters. No trace of hypogynous bristles. Style long, trifid ... 1. *S. holoschoenus*.

B. Large or middle sized. Stems leafy only near the base. Inflorescence various, but spikelets not spicate. Hypogynous bristles often present. Style long

2

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I. Nut marked with transverse wavy lines; hypogynous bristles 0
  1. Stems flowering nearer to the top than the base, slender, obtusely trigonous; glumes 2.5 mm. long, with tapering (not subcordate) base, not inflated in front, strongly keeled ... ... 2. *S. supinus.*
  2. Stems stout, septate when dry, head usually near the base of the stem. Nut triquetrous ... ... 3. *S. articulatus.*
  3. Stems rather slender, head usually above the middle of the stem. Spikelets yellowish, flaccid, glumes 5-ranked, concave, inflated in the upper part. Nut triquetrous 4. *S. quinquefarius.*

II. Nut not marked with transverse wavy lines
  1. Hypogynous bristles 0 ... ... 5. *S. corymbosus.*
  2. Hypogynous bristles present
    a. Hypogynous bristles retroversely scabrid (not plumose)
      † Glumes bifid at apex
        § Bristles usually somewhat shorter than the nut, often unequal ... 6. *S. maritimus.*
        §§ Bristles often about as long as nut 7. *S. triqueter.*
      †† Glumes not bifid at apex ... 8. *S. grossus.*
    b. Hypogynous bristles plumose ... 9. *S. littoralis.*

III. Nut more or less distinctly marked with transverse wavy lines. Hypogynous bristles present
  1. Stems stout, septate wren dry, head usually near the apex of the stem. Nut triquetrous ... ... 10. *S. mucronatus.*
  2. Stems medium, heads usually near the apex of the stem; spikelets few, terete, turgid, ovate, acute; glumes broad, incurved, shortly aristate. Nut plano-convex or biconvex ... ... 11. *S. erectus.*

C. Small tufted herbs with slender stems, never reaching 30 cm.; hypogynous bristles 0
  I. Perennial herb ... ... 12. *S. kyllingoides.*
  II. Annual herb; glumes trapeziform; cusp as long as the blade; bracts 1-3, reaching 2.5 cm. long ... ... 13. *S. squarrosus.*

1. **Scirpus holoschoenus** Linn. Sp. Pl. 72; C. B. Clarke in Hook. f. F.B.I. vi, 655.—*Ibidem* synonyms.

Description: Rhizome horizontal, woody, covered by ovate chestnut scales; fibrous roots thick, often (when growing in sand) woolly. Stems 20-75 cm., approximate, terete. Leaves all near the base of the stem, sometimes 15 cm. long, usually shorter, or reduced almost to sheaths. Umbel simple or very compound of 1-80 usually (2-10) heads; lowest bract sometimes 10-20 cm., sometimes 8-25 mm. Spikelets scarcely 5 mm., ellipsoid, dense-flowered. Glumes ovate, keel subexcurrent, tip hairy (rarely glabrous). Stamens 3; anthers red-crested. Nut small, as long as $\frac{1}{2}$-$\frac{2}{3}$ glume, subtriquetrous, obtuse, minutely apiculate; outermost cells minute, quadrate-hexagonal, obscure, withering (nut more or less white-veiled by such withered fragments on the dark nut).

Locality: *Sind*: (Pinwill ex Clarke).
Distribution: Punjab, Sind.—W. Asia, Africa, Europe.

2. **Scirpus supinus** Linn. Sp. Pl. (1753) 49; Cke. ii, 892.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 655.
Description: Cke. l.c.
Locality: *Sind*: (Pinwill ex Cooke).—*Gujarat*: Dakor (Karnitkar ex Cooke).—*W. Ghats*: Igatpuri (Blatter & Hallberg 3207 !); Khandala, in marsh land

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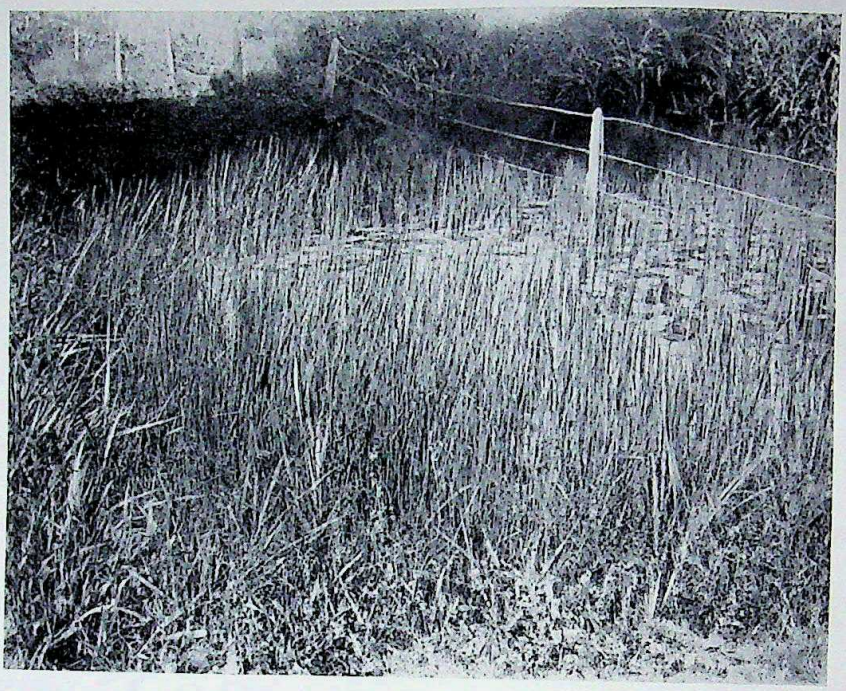

Scirpus articulatus L. in a pool near Malad, Salsette Island.

Photos by C. McCann.

Scirpus corymbosus Heyne, Tableland, Pachgani.

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(McCann C11 !), in a marsh near station (McCann 383 ! 386 ! 387 ! 390 !); Lonavla (Blatter, Hallberg & McCann 28387 !); Panchgani (Blatter & Hallberg B1499 !).—*Deccan*: Varawandi, Ahmednagar Dist. (Herb. Sedwgick & Bell 7368 !); Bairawadi, Purandhar (Blatter & McCann 5579 ! 5581 !).—*Konkan*: (Law ex Cooke); Kalyan (H.E.B.B. !, Woodrow ex Cooke); Nagothna to Pen (Gammie 16088 !); Pen (Blatter, Hallberg & McCann 3226 !); Bansda (Woodrow ex Cooke).—*S. M. Country*: Devarayi (Sedgwick 4420 !); Yelvigi, Dharwar Dist. (Sedgwick 3701 !).—*N. Kanara*: Karwar, rice fields (Sedgwick 6719 !, Talbot 1115 !, Hallberg & McCann C178 ! C179 !).

Flowering & fruiting: January 1917 (Igatpuri); February 1917 (Pen); February 1918 (Yelvigi); February 1920 (Varawandi); March 1929 (Khandala); September 4th, 1896 (Kalyan); October 1918 (Lonavla, Devarayi); October 1919 (Karwar); October 1920 (Panchgani); November 1918 (Khandala); December 1917 (Bairawadi); December 14th, 1902 (Nagothna to Pen).

Field notes: A plant commonly met with in marshes throughout the year. Usually partially in water. Spikelets pale green or straw-coloured.

Distribution: More or less throughout India, except Assam—Old World generally and in America.

Var. **uninodis** C. B. Clarke in Hook. f. F.B.I. vi, 656; Cke. ii, 892.—*S. mucronatus* Roxb. Fl. Ind. i (1832) 216 (*non* Linn.).

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Clarke).

Distribution: Bengal, Sind, Coromandel.—Ethiopia, Java, Queensland.

3. **Scirpus articulatus** Linn. Sp. Pl. (1753) 47; Cke. ii, 891.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 656.

Description: Cke. l.c.

Locality: Without locality (Dalzell !).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: Godhra (Chibber 593 !); Talod, marshy land near tank (Saxton 568 !); Sonasan, by a small tank (Sedgwick 329 !); Dakor (Karnitkar ex Cooke).—*W. Ghats*: Khandala (McCann 27447 !).—*Konkan*: (Woodrow ex Cooke); Sion (Blatter & McCann 3071 !); Uran, Bombay Harbour (Hallberg & McCann 2740 !); Bandra (Herb. St. X. C. 3080 !); Kondita, Salsette (Blatter & McCann 3081 !); Borivli (Chibber !); Pali to Nagothna (Gammie !); Gokhirwa, Bassein (Ryan 85 !); Borivli, in a ditch (McCann 1118 ! 1118a ! 1118b ! 1119 ! 1119a !); Goregaon to Malad, in a ditch (McCann 1348 !); near Malad in a ditch (McCann 1357 !); Varol Tank, Bhivandi, near Kalyan (McCann 1727 !); Bhivandi (Chibber !).—*S. M. Country*: Havasbhavi, 2,000 ft., rainfall 35 in. (Sedgwick 1949 !) tanks W. of Kunnur, Dharwar Dist. (Sedgwick 4919 !); Kulgeri, tank (Bhide !).—*N. Kanara*: Karwar, on edge of tank (Hallberg & McCann C10 !); Kumpta, rice fields (Talbot !).

Flowering & fruiting: January 1917 (Uran); January 2nd, 1912 (Borivli); January 30th, 1912 (Bhivandi); May 1919 (Khandala); September 6th, 1911 (Dharwar); September 15th, 1929 (Borivli); September 29th, 1929 (Goregaon to Malad; near Malad); October 1919 (Karwar); November 1916 (Sion); November 21st, 1902 (Gokirwa, Bassein); December 1902 (Pali to Nagothna); December 1915 (Sion, Bandra); December 1916 (Kondita, Havasbhavi); December 1918 (W. of Kunnur); December 5th, 1907 (Godhra).

Field notes: A late comer among the *Cyperaceae*. Flowering takes place about the first week of September. The plants first appear in July and August, but at this time life is spent under water, and the juvenile state does not look anything like one of the *Cyperaceae*. The leaves in the juveniles never appear above the water; they are long, tufted, ribbon-like structures. Soon after the inflorescence appears the leaves decompose and fall away leaving a spathe surrounding each culm. The culms are erect, hollow (not spongy), light green, with thin white septa at intervals. In fresh specimens the septa are as clearly visible as in dried specimens. The height of the inflorescence on the culm depends on the depth of the water at the time when the plant is coming into flower. Thus we have individuals with the inflorescence well up the culms and others with the inflorescence low down near the base. This may be said to be an 'amphibious' species—the early stages being spent under water, while the plant in flower exists on moist ground long after the monsoon.

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The Floras give, leaves 0. This is incorrect as the leaves appear before the inflorescence-bearing culms, and unless known to be those of *S. articulatus*, appear to be quite different from those of any of the *Cyperaceae*. Specimens in McCann's herbarium clearly show this. The Borivili specimens are particularly interesting as they show the juvenile state of this species (McCann No. 1118); while McCann No. 1119 proves that the species has leaves.

Distribution: Throughout India.—Ceylon, Africa, Philippines, Australia.

4. **Scirpus quinquefarius** Ham. in Wall. Cat. (1828) 3465; Cke. ii, 892.

Description: Cke. l.c.

Locality: *Sind*: (Pinwill ex Cooke, Blatter & McCann C3113 !, H.E.B.B. !); Rhubak (Woodrow !); Gholam (Blatter & McCann D740 !), in a field (Blatter & McCann D741 !); Tatta (Blatter & McCann D742 ! D743); Bughar, on the Indus (Blatter & McCann D744 !).—*Cutch*: (Stoliczka ex Clarke).—*Gujarat*: (Hove ex Clarke); Ahmedabad (Gammie 16361 !); Munnagar, rice fields, Ahmedabad Dist. (Sedgwick 332 !); Talod (Saxton 708 !); Umrat (Woodrow ex Cooke).—*Deccan*: Varawandi, Ahmednagar Dist. (Herb. Sedgwick & Bell 7370 !); Poona (H.E.B.B. !).—*Konkan*: (Dalzell ex Cooke). Though Cooke has seen a specimen we doubt very much whether this species occurs in the Konkan.

Flowering & fruiting: February 1920 (Varawandi); October 24th, 1903 (Ahmedabad); December 1892 (Bhubak).

Distribution: N.-W. India, Central India, W. Bengal, Sind, Cutch, Gujarat, Deccan.—Afghanistan, Baluchistan, Africa.

5. **Scirpus corymbosus** Heyne ex Roth. Nov. Pl. Sp. (1821) 28; Cke. ii, 892. Synonyms in C. B. Clarke in Hook. f. F.B.I. vi, 657.

Description: Cke. l.c.—'Stem round or slightly oval, firm but spongy' (Fernandez).

Locality: Without locality (Dalzell !).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: Kabir Vad, Broach Dist. (Chibber !).—*Khandesh*: Dhulia, Thikki tank (Chibber !).—*W. Ghats*: Panchgani, in rocky pool on Third Tableland (Fernandez C147 ! C148 ! C149 !), in mud along banks of monsoon pools (Fernandez C150 ! C151 !), Second Tableland (Blatter & Hallberg B1733 !).—*Goa*: (Herb. St. X. C. 3112 !, Herb. Woodrow !).

Flowering & fruiting: September 28th, 1928 (Panchgani); October 1920 (Panchgani); November 26th, 1929 (Panchgani); December 10th, 1907 (Kabir Vad); December 28th, 1907 (Dhulia).

Field notes: A tall densely growing species with terete striate spongy stems. At Panchgani we have found this species forming almost pure associations in the shallow pools and lakes on the tablelands. It commences to flower in September and remains erect long after the monsoon, even after the pools have dried up. The roots are densely matted in the clayish soil. Here we have found it associated with *Elecocharis fistulosa* Link.

Distribution: Bundelkhand, Sind, Gujarat, Khandesh, Deccan, N. Kanara, Mysore.—Africa, Madagascar.

6. **Scirpus maritimus** Linn. Sp. Pl. (1753) 51; Cke. ii, 893.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 658.

Description: Cke. l.c.

Locality: *Sind*: (Dalzell & Stocks 1094 ex Cooke); Karachi (Woodrow ex Cooke, H.E.B.B. !); Mirpur Sakro (Blatter & McCann D745 ! D746 ! D747 !); Tatta (Blatter & McCann D748 ! D749 !), in a lake (Blatter & McCann D750 !); Bughar, on the Indus (Blatter & McCann D751 !).—*Cutch*: Banner (Blatter 3733 !); Anjar (Blatter 1978 !).—*Gujarat*: Chharod Farm (Javlekar !); Umreth (Clarke !, Woodrow ex Cooke); Godhra (Chibber !), tank (Chibber 347 !); Kabir Vad, Broach Dist. (Chibber !); Kharagoda (Saxton 482b !); Mishwa River Harsol (Sedgwick !).—*Kandesh*: Dhulia (Chibber !).—*Deccan*: Miraj (Woodrow ex Cooke).—*Konkan*: Bombay (Woodrow ex Cooke), race-course (Blatter & McCann 3203 !); Mahim (McCann 5265 !); Parsik, railway line (Blatter & McCann 28920 !); Bandra (Herb. Sedgwick & Bell 7400 !); Sion (Blatter & McCann 2376 !); common in marshes near Diva and Kalyan (McCann !); Kurla, in marshes (McCann !).—*S. M. Country*: Tank near Yelvigi, Dharwar Dist., 1,800 ft., rainfall 28 in. (Sedgwick 3605 !).—*N. Kanara*: Haveri (Talbot 2226 !).

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Flowering & fruiting: January 1920 (Bandra); January 2nd, 1890 (Haveri); February 1918 (Yelvigi); March 1917 (Bombay); April 26th, 1909 (Chharod); April 29th, 1904 (Karachi); June 1917 (Sion); August 1914 (Harsol); October 11th, 1914 (Kharagoda); November 9th, 1907 (Godhra); November 15th, 1916 (Mahim); November 29th, 1907 (Godhra); December (Bombay); December 1907 (Banner); December 1907 (Anjar); December 1915 (Sion); December 1918 (Parsik); December 10th, 1907 (Kabir Vad); December 28th, 1907 (Dhulia).

Field notes: The typical form is the commonest in marshes near the sea and also inland. It is extremely common in the beds of tanks and pools that dry up during the dry season, flowering after the water has dried but when the soil is still marshy. The plants arise in tufts or singly from the long rhizomes. A tough plant usually persisting throughout the dry season and breaking up in the next monsoon.

Uses: 'The seeds are used and the plant produces them abundantly' (Gammie).

Distribution: Kashmir, Kashgar, Moradabad, Rajputana Desert, Bombay Presidency, Mysore, Nellore.—Old World, with varieties in Australia and America.

var. **affinis** C. B. Clarke in Hook. f. F.B.I. vi, 659; Cke. ii, 893.

Description: Cke. l.c.

The Sangli specimens have from 4 to 5 spikelets.

Locality: *Sind*: (Dalzell ex Cooke, Stocks 82 ex Clarke, Pinwill ex Clarke).—*Gujarat*: Ahmedabad (Chibber !, Saxton 1819 !); Surat (Gammie 16448 !); Sabarmati (Sedgwick !).—*Khandesh*: Bhusawal (Gammie !).—*Deccan*: Nasik (Clarke 4 !, Cooke).—*Konkan*: Bombay (Law ex Cooke); race-course (Blatter, Hallberg & McCann 3200 ! 3203 !).—*S. M. Country*: Kudchi, near Miraj (Blatter 3111 !); Sangli, riverbank (Blatter C40 ! C41 ! C42 !); Kolhapur Wadi (H.E.B.B. !); Bagalkot, riverbank (H.E.B.B. !).

Field notes: This variety is the common form met on riverbanks and is extremely variable. Some of the specimens appear to be intermediate between the variety and the typical form.

Distribution: Throughout N. India, in the plains, from the Punjab and Bombay to Assam and Pegu.—N. Asia, Turkestan, N. China, Amurland.

7. **Scirpus triqueter** Linn. Mant. 29; C. B. Clarke in Hook. f. F.B.I. vi, 658.

Description: Glabrous, stoloniferous. Stem 25-75 cm. long, nearly leafless, triquetrous at the top, with one lateral head, or a simple umbel of heads; lowest bract as though a continuation of the stem, triquetrous, 2.5-7.5 cm. long, acute. Spikelets 3-10, up to 1.3 by 0.5 cm., cylindric, obtuse, brown. Glumes ovate, scarious at the tip, notched, with a minute bristle in the notch; hypogynous bristles 3-4 (or 6), often overtopping the nut, dark brown, obscurely scabrous. Stamens 3; anthers linear-oblong, not crested. Nut more than half the length of the glume, obovoid, much dorsally compressed, pale, finally brown, smooth; style shorter than the nut; branches 2, long, sparingly papillose, slightly fusiform.

Locality: *Sind*: (Pinwill ex Clarke).

Distribution: Kashmir, Baltistan, 6,000-8,000 ft., Sind.—Europe, Central Asia to Japan, S. Africa.

8. **Scirpus grossus** Linn. f. Suppl. (1781) 104; Cke. ii, 893.—*S. Kysoor* Roxb. Hort. Beng. (1814) 6; Fl. Ind. i (1832) 230; Cke. i, 894.—*S. grossus* var. *Kysoor* C. B. Clarke in Hook. f. F.B.I. vi, 660.

Description: Cke. l.c. See also Haines Bot. Bih. & Or. 927.

In the Poona Herbarium we examined 23 sheets including 4 sheets determined by Clarke in 1896 (May 1st, 1896) as *S. grossus* Linn. f. The hypogynous bristles in these cases are plumose or shortly ciliate. In the remainder they are plumose or ciliate. Another specimen obtained at Bassein by Ryan has the bristle shortly ciliate. The bristles are generally red. In young specimens we can find no trace of hypogynous bristles which may be developed later.

We are quite unable to distinguish between *S. grossus* and *S. Kysoor* which we think may only be a form. Is this character alone, namely the presence of plumose bristles, sufficient to make a new species of one which otherwise

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answers to the description of *S. grossus*? We do not feel justified in keeping the two apart and therefore unite them under the older name of *Scirpus grossus* Linn. f.

Locality: *Sind*: (Pinwill ex Clarke).—*Deccan*: Poona (H.E.B.B. !); College of Science garden (H.E.B.B. !, Garade 594 !).—*Konkan*: Beds of rivers in both Konkans (Graham ex Cooke); Bombay (Dalzell ex Cooke); Borivli to Kanari Caves, on the margin of a tank, in water (McCann 1097 ! 1098 ! 1101 !); Borivli (Chibber !); Bhandup (Blatter & McCann 2752 !, McCann C45 !); Bassein (Ryan 1853 !, Chibber !); Bhivandi (Bhagawat !); near Kalyan, Varol Tank (McCann 1687 !).

Flowering & fruiting: January 2nd, 1912 (Borivli); June 1892 (Poona); July 24th, 1902 (Poona[1]); September 15th, 1929 (Borivli to Kanari Caves); October 9th, 1903 (Bassein); November 1916 (Bhandup); December 1919 (Bhandup).

Field notes: Purely a marsh sedge appearing during the monsoon. It flourishes best where the soil is soft and sticky. The inflorescences appear in August. The stems are very sharply triquetrous with concavities between the angles. The margins of the leaves and bracts are minutely serrulate, thus offering a cutting edge if brushed the wrong way. The teeth are weak. As the tanks and pools in which they flourish dry up, the plants also dry. During life the plants send out long stolons which produce large tubers, often more than 2.5 cm. in diameter.

Uses: The tubers are much sought after by local people for food. The plant is used for coarse matting in Bengal.

Distribution: Throughout India, except the N.-W.—Malaya, Tonkin, Philippines.

9. **Scirpus littoralis** Schrad. Fl. Germ. i (1806) 142, t. 5, fig. 7; Cke. ii, 894.—Synonyms in C. B. Clarke in Hook. f. F.B.I. vi, 659.

Description: Cke. l.c.

The Tatta specimens were identified as *Fimbristylis ferruginea* by Vakil in the Flora of the Indus Delta.

Locality: *Sind*: (Dalzell ex Cooke); Tatta (Blatter & McCann D737 ! D738 !).—*Kathiawar*: (Mehta ex Drummond ex Cooke); Rajkot (H.E.B.B. !, Cooke).—*Gujarat*: Dharsana (Chibber !); Kharagoda, in a tank, in 3 ft. of water (Saxton 493b !); Watrak River, Modasa Petha (Sedgwick 1172 !); in sandy bed of stream, Gorair Bridge, Chitrasani to Sarotra (McCann 1394 ! 1394a !); Ahmedabad (Burkhill ex Drummond ex Cooke).—*N. Kanara*: Karwar (Talbot !).

Flowering & fruiting: August 30th, 1885 (Karwar); October 11th, 1914 (Kharagoda); October 24th, 1929 (Chitrasani to Sarotra); December 1915 (Watrak River); December 27th, 1911 (Dharasana).

Field notes: A hygrophylous species commonly met with in pools along banks of rivers and tanks. Long leaves are developed under the surface or float near the top of the water. As soon as the water begins to dry the leaves decay and fall away leaving the culm and the inflorescence. The culms remain standing for quite a long period after the rains. Long creeping stolons are given off which frequently make the plant look as though it were growing in rows.

Distribution: Punjab, Central India, Rajputana Desert, Sind, Kathiawar, Gujarat, N. Kanara, Cuddapah, Kurnool, Chingleput, Travancore, up to 2,000 ft.—Ceylon, Persia, Central Asia, Africa, Mediterranean region.

10. **Scirpus mucronatus** Linn. Sp. Pl. 73; C. B. Clarke in Hook. f. F.B.I. vi, 657.—*Ibidem* synonyms.

Description: Glabrous. Roots fibrous, or rarely a horizontal rhizome 10-15 cm. long. Stems tufted, 15-75 cm. long, stout, triquetrous, bearing one apparently lateral head; lowest bract trigonous, appearing as a continuation of the stem, 1.3-9 cm. long. Leaves 0. Spikelets few or numerous 5-13 mm. long, ellipsoid, subacute. Glumes ovate, subacute, nearly entire at the tip. Hypogynous bristles usually 5 (or 6), unequal, some nearly as long as the

[1] Most of the Poona material is duplicate material or sheets without locality. Only one sheet identified by Clarke bears date and locality.

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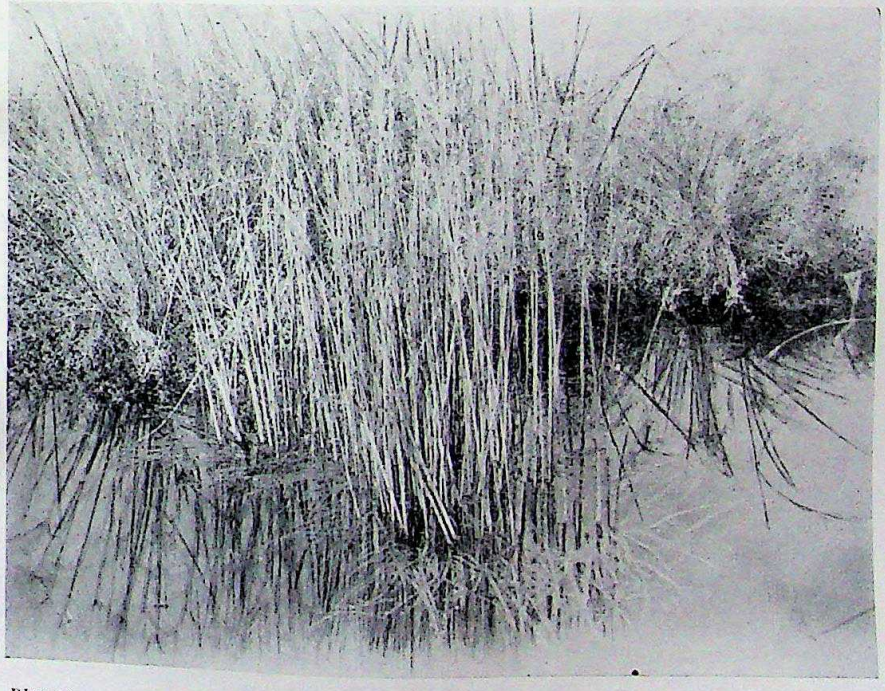
Inflorescences of *Scirpus grossus* L. near Borivli, Salsette Island.



Photos by C. *McCann.*

Scirpus litoralis Schrad. Benas River, Abu Road. Note the submerged leaves.

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nut, brown, retrorse scabrid (but the bristles are sometimes small and occasionally 0). Style linear; branches 3. Nut less than half the length of the glume, obovoid, trigonous, shining black-chestnut, smooth or obscurely transversely wavy.

Locality: *Gujarat*: The Bokh, Prantij, Ahmedabad Dist. (Sedgwick 1278 !). —*Konkan*: (Law ex Clarke).—*S. M. Country*: Tegur, Dharwar-Belgaum Road, in a nala fed by a perennial stream, 2,000 ft., rainfall 30 in. (Sedgwick 5504 !). —*W. Ghats*: Londa (Gammie 14072 !).—*N. Kanara*: (Talbot 588 ex Clarke); Yellapur (Talbot 588 !).

Flowering & fruiting: March 1919 (Tegur); April 1916 (Prantij); May 21st, 1900 (Londa).

Distribution: Throughout India, up to 6,000 ft.—Europe, tropical Africa, Madagascar, W. Asia to Japan, Australia, Polynesia.

11. **Scirpus erectus** Poir. Encycl. vi (1804) 761; C. B. Clarke in Hook. f. F.B.I., vi, 656.—*Ibidem* synonyms.

Description: Roots fibrous. Stems 10-38 cm. high, terete, tufted, sheaths with an oblique mouth, sometimes produced in a short erect blade. Spikelets 1-3 in a single lateral head near the apex of the stem, 6-13 mm. long. Glumes broadly ovate, acute, concave, keel not very prominent. Bristles 5-6, retrorsely scabrid (rarely 0, C. B. Clarke). Style usually 2-fid. Nut 2 mm. long, planoconvex, broadly obovoid, apiculate, slightly transversely undulate, straw-coloured, brown, ashy-grey, finally usually nearly black.

Locality: *S. M. Country*: Devarayi, in a marsh (Sedgwick 4045 !).—*N. Kanara*: Anmod, rice fields (Sedgwick 3274 !, Talbot 3133 !).

Flowering & fruiting: June 1918 (Devarayi); December 1917 (Anmod).

Distribution: Throughout India.—Ceylon, temperate Asia, N. America, Australia.

12. **Scirpus kyllingoides** Boeck. in Linnaea xxxvi (1870) 733; Cke. ii, 895.

Description: Cke. l.c.

Locality: *N. Kanara*: (Young ex Clarke).

Distribution: N.-W. India, Bengal, Mt. Abu, Rajputana, N. Kanara.—Tropical Africa.

13. **Scirpus squarrosus** Linn. Mant. (1771) 181; Cke. ii, 896.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 663.

Description: Cke. l.c.

Locality: Without locality (Herb. St. X. C. 3108 !).—*Sind*: (Pinwill ex Clarke).—*Gujarat*: Sevalia, Kaira Dist. (Chibber !).—*N. Kanara*: (Talbot 867 !); sandy fields by the sea, Karwar (Sedgwick 5087 !, Talbot 1511 !).—*W. Ghats*: Dudhsagar Falls, near Castle Rock (McCann C128 ! C177 !).

Flowering & fruiting: March 1919 (Dudhsagar); August 1885 (Karwar); December 1918 (Karwar); December 3rd, 1907 (Sevalia).

Distribution: More or less throughout India.—Ceylon, tropical Africa, Java, China.

11. Eriophorum Linn. (Cke. ii, 896).

Species 15.—N. temperate, chiefly in wet moors.

1. **Eriophorum comosum** Wall. Cat. (1828) 3446; Cke. ii, 896.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 664.

Description: Cke. l.c.

Locality: Without locality (Dalzell !).—*Sind*: (Pinwill ex Cooke).—*Gujarat*: Champanir (Woodrow ex Cooke).—*Khandesh*: N. of Chanseli Hill, Taloda taluka (Blatter, Hallberg & McCann 29580 !).—*Deccan*: Shivneri Fort, Junnar (Paranjpye, several sheets !); W. Deccan near Junnar (Dalzell & Gibson); near Junnar (Bhiva ex Cooke).

Flowering & fruiting: March 22nd, 1911 (Junnar); May 10th, 1912 (Shivneri Fort); December 1918 (Chanseli).

Field notes: A densely tufted sedge, growing pendulous from perpendicular rock faces in cracks and fissures. The whole plant is flexuous.

Uses: Used to make ropes.

Distribution: Throughout India.—Tonkin, China.

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12. FUIRENA Rottb. (Cke. ii, 897).

Species 25.—Tropics and subtropics.
Key in Cke. ii, 897.

1. **Fuirena Wallichiana** Kunth Enum. ii (1837) 182; Cke. ii, 897.—For snyonyms see C. B. Clarke in Hook. f. F.B.I. vi, 665.
Description: Cke. l.c.
Locality: *Khandesh*: Dhulia, Noti Tank (Chibber !).—*Deccan*: Watery places (Dalzell ex Cooke); Poona (Woodrow 882, Jacquemont 413 ex Cooke, Herb. St. X. C. 3103 !, Garade 648 !, Gammie !, Paranjpye !, H.E.B.B. !); Pashan (Paranjpye !); Varawandi, Ahmednagar Dist. (Herb. Sedgwick & Bell 7388 !); between Nadsur and Pali, in rice fields (Gammie 16038 !).—*S. M. Country*: Dharwar, in clumps of *Pennisetum alopecuros*, 2,400 ft., rainfall 34 in. (Sedgwick 6147 !); Mugadkhan, Hubli, in a canal (Bhide !).—*W. Ghats*: Londa (H.E.B.B. !); Castle Rock (Gammie !).
Flowering & fruiting: February 1920 (Varawandi); July 1919 (Dharwar); July 25th, 1912 (Pashan); September 26th, 1902 (Pashan); October 23rd, 1914 (Pashan); December 8th, 1910 (Hubli, Mugadkhan); December 27th, 1907 (Dhulia).
Distribution: N.-W. India, Central India, Khandwa, Khandesh, Deccan, S. M. Country, N. Coimbatore Hills.

2. **Fuirena ciliaris** (Linn.) Roxb. Hort. Beng. (1814) 81.—*Scirpus ciliaris* Linn. Mant. 182.—*Fuirena glomerata* Lam. Ill. i, 150; Cke. ii, 898.
Locality: *Kathiawar*: Suchipur (Herb. Col. of Sc. now in Calcutta !).—*Gujarat*: Sonasan, in rice fields (Sedgwick 330 !); Godra (Woodrow ex Cooke).—*Konkan*: (Stocks, Law ex Cooke); Bhandup (Blatter & McCann C35 ! 2751 !); Vetora (Sabnis 33764 !); Pen (Blatter, Hallberg & McCann 3230 ! 3231 ! 3233 !); Thana Dist. (Bell 3625 !); Savantvadi (Woodrow ex Cooke); rice fields (Blatter 3105 !); Kulgaum, rice fields (Herb. Woodrow !).—*W. Ghats*: Igatpuri (Blatter & Hallberg 3008 !); Castle Rock, 1,800 ft., rainfall 300 in. (Bell 4353 !); Londa (Herb. Col. of Sc., now in Calcutta !).—*S. M. Country*: Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4418 !, McCann C44 !); Byadgi, Dharwar Dist., 2,000 ft., rainfall 33 in., fields (Sedgwick 1972 !).—*N. Kanara*: (Talbot 1032 ex Clarke); Karwar (Talbot 1532 !, Hallberg & McCann C36 ! C37 !); sandy fields (Sedgwick 5094 !); Yellapur (Talbot 779 !).
Flowering & fruiting: January 1917 (Igatpuri); January 1919 (Bhandup); February 1917 (Pen); February 1918 (Thana Dist.); March 1919 (Devarayi); September 1918 (Castle Rock); September 20th, 1884 (Yellapur); September 25th, 1885 (Karwar); October 1902 (Castle Rock); October 1914 (Sonasan); October 1918 (Vetora, Devarayi); October 1919 (Karwar); October 26th, 1883 (Yellapur); November 1891 (Kulgaum); November 1st, 1883 (Yellapur); November 5th, 1891 (Londa); November 1916 (Bhandup); November 1917 (Savantvadi); December 1916 (Byadgi); December 1918 (Karwar); December 9th, 1902 (Nadsur to Pali).
Distribution: Throughout the warmer parts of India, common in rice fields.—Ceylon, tropical Africa, S.-E. Asia, Australia.

3. **Fuirena uncinata** Kunth Enum. ii (1837) 184; Cke. ii, 898.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 666.
Description: Cke. l.c.
Locality: *N. Kanara*: (Thomson ex Cooke); Gersoppa Falls (Hallberg & McCann C38 ! C39 !), on sand (Sedgwick 7148 !); Karwar (Talbot 1312 !), sandy rice fields (Sedgwick 5032 !); Jugglepet (Talbot 1570 !).
Flowering & fruiting: September 20th, 1885 (Karwar); October 1919 (Gersoppa Falls); November 15th, 1885 (Jugglepet); December 1918 (Karwar).
Distribution: N. Kanara, E. districts from Ganjam to Chingleput, Salem and Coimbatore, sea-level to 2,000 ft.—Ceylon.

4. **Fuirena umbellata** Rottb. Descr. *et* Ic. (1773) 70, t. 19, fig. 3; Cke. ii, 899.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 666.
Description: Cke. l.c.

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Talbot's No. 1032 was identified by Clarke as *F. glomerata*. We cannot agree. The following is a note by Clarke in Talbot's sheet No. 1032:

'*Fuirena glomerata*, Lam. This has been marked *F. pubescens*, Kunth (doubtless) because the squamellae are 0. The squamellae are difficult to see when very young as in these examples. If the young ovary is soaked in water the 3 young squamellae will separate off it as infinitely thin scarious scales, but having the exact battledore form and nervation of the squamellae as *F. glomerata*. C. B. Clarke. December 1884.'

These sheets are in the herbarium at Calcutta.

Locality: *Deccan*: Alandi (Woodrow ex Cooke).—*W. Ghats*: Castle Rock (Herb. St. X. C. 3104 !, Sedgwick 3397 !, Bhide !, Herb. Woodrow !); Londa (Woodrow ex Cooke), bank of a stream (Bhiva Babajee ! Col. of Sc. now in Calcutta).—*N. Kanara*: Yellapur (Sedgwick 5840 !, Talbot 1032 !).

Flowering & fruiting: April 1919 (Yellapur); October 1919 (Sampkhand, Gersoppa Falls); October 10th, 1884 (Yellapur); November 10th, 1911 (Castle Rock); November 14th, 1890 (Castle Rock); December 1917 (Castle Rock).

Distribution: More or less throughout India.—Ceylon, most warm, not too dry countries.

13. Lipocarpha R. Br.

Glabrous herbs; rhizome 0 or short. Stems tufted, obtusely triangular. Leaves grass-like, from the base of the stem only. Spikelets 1-20 in a single terminal bracteate head, many-flowered. Glumes spirally imbricate, 1-2 lowest empty, uppermost few tabescent, intervening bisexual, falling away successively from the base of the persistent rhachilla. Hypogynous bristles replaced by 2 subequal opposite hyaline scales more or less adherent to the nut. Stamens 1-3, usually 2. Style short, slender, stigmas 2, sometimes 3. Nut sessile, plano-convex or trigonous, obovoid or linear-oblong, smooth, usually minutely punctate.—Species 7.—Tropics.

1. Spikelets whitish ... ... 1. *L. argentea.*
2. Spikelets dark chocolate-brown, smaller than the last ... ... 2. *L. triceps.*

1. **Lipocarpha argentea** R. Br. in Append. Tuckey Congo 459; C. B. Clarke in Hook. f. F.B.I. vi, 667.—*Ibidem* synonyms.

Description: Glabrous, annual; stems 15-60 cm. long, tufted, nearly round, each with one head. Leaves $\frac{1}{5}$-$\frac{2}{3}$ the length of the stem, 2.5 by 5 mm. broad, almost without a midrib; bracts 3-4, lowest 2.5-10 cm. long, spreading. Spikelets 1-5 sometimes 10 in the head, usually 6 by 4 mm. (but they lengthen in fruit sometimes up to 2 cm.), dense, with numerous flower-glumes, white or straw-coloured; rhachilla persistent; glumes narrowly obovate-truncate, rather thick, deciduous seriatim from the base or the spikelet leaving the rhachilla prominently covered by lozenge-shaped scars; lower bracteole $\frac{2}{3}$ the length of the glume, hyaline, obtuse, 5-nerved, central nerve sometimes green (so thin that if the nut is placed in water the bracteoles enclosing it may be easily overlooked under a microscope); upper bracteoles similar but narrower; stamens usually 2. Nut sessile, shorter than the bracteoles, obovoid-ellipsoid, trigonous, smooth, dark brown, reticulate. Style linear, branches 3, linear, rather short.

Locality: *W. Ghats*: Castle Rock, 1,800 ft., rainfall 300 in. (Sedgwick 3426 !).—*N. Kanara*: Siddhapur, rice fields (Sedgwick 7017 !); Yellapur, Arbail Ghat, 1,800 ft., rainfall 200 in. (Sedgwick 5848 !, Talbot !); Sampkhand (Hallberg & McCann C7 !).

Flowering & fruiting: April 1919 (Yellapur); September 1st, 1884 (Yellapur); October 1919 (Siddhapur, Sampkhand); December 1917 (Castle Rock).

Distribution: From the W. Himalaya, up to 6,000 ft. from the Kangra Dist. to Assam.—Tropics and subtropics of the Old World.

2. **Lipocarpha triceps** Nees in Wight Contr. (1835) 92.—*Tunga triceps* Roxb. Fl. Ind. (1832) 183.—*L. sphacelata* Kunth Enum. ii (1837) 267; C. B. Clarke in Hook. f. F.B.I. vi, 667.

Description: Glabrous. Stems annual, tufted, 10-40 cm. long, trigonous, striated, smooth. Leaves $\frac{1}{4}$-$\frac{1}{2}$ the length of the stem, linear. Spikelets 3-18

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in the head, 8 by 3 mm., cylindric, very dense, obtuse, smooth, usually purple or dark reddish, sometimes paler; bracts 3-7, spreading, up to 2.5-10 cm. long. Glumes obovate, with a triangular tip erect or incurved in fruit. Hyaline scales a little shorter than the glumes, lower narrowly elliptic, upper oblong. Nut broadly oblong, round-trigonous, nearly as long as the hyaline scale, black-brown, smooth. Style 0 or hardly any; branches 3, linear, shortly exserted.

'This species was sorted from *L. argentea* (the white-headed) by its deep purple-spotted (sphacelate) heads; but the character is not a safe one any more than the number of spikelets (triceps). The length of the style draws a strong line between the two.' (C. B. Clarke.)

Locality: *S. M. Country*: Bidi, Belgaum Dist., 2,000 ft., rainfall 50 in. (Sedgwick 3062 !); Havasbhavi, 2,000 ft., rainfall 30 in. (Sedgwick 2156 !).—*N. Kanara*: Sirsi to Siddhapur (Hallberg & McCann C9 ! C46 !); Karwar Dist. (Chibber !); Karwar, rice fields (Talbot 1534 !).

Flowering & fruiting: September 1917 (Bidi); October 1919 (Sirsi to Siddhapur); November 1910 (Karwar Dist.); December 1916 (Havasbhavi).

Distribution: Throughout India, except the dry N.-W., up to 2,000 ft., from Nepal and Assam to Ceylon and Tavoy.—Tropical Africa and America.

14. Rhyncospora Vahl (Cke. ii, 900).

Species 175.—Temperate and tropics.

Cooke has 3 species. His *R. Wallichiana* has to be excluded as the only specimen he has heard of is not this species but *R. Wightiana*. His *R. aurea* has to be changed to *R. corymbosa*.

1. Stem leafy towards the base only. Spikelets in a single terminal head ... ... 1. *R. Wightiana*.
2. Stem leafy throughout its entire length. Spikelets in paniculately arranged corymbs 2. *R. corymbosa*.

1. **Rhyncospora Wightiana** Steud. Cyper. (1855) 148; Cke. ii, 901.

Description: Cke. l.c.

We have examined Woodrow's Kalyan specimen and found it is this species and not *R. Wallichiana*.

Locality: *W. Ghats*: Igatpuri (McCann 2381 !, Blatter & Hallberg 2812 !); Khandala (Jacquemont 649 !, Woodrow ex Cooke), wet grassy banks (Sedgwick 2589 !, McCann 28067 ! 29550 !, Gammie 15401 !, Saxton 1195 !); Lonavla (Bhide !, Chibber !); Castle Rock (Gammie 15699 !, Bhide !).—*Deccan*: Poona (Woodrow ex Cooke).—*Konkan*: (Law ex Cooke); Trombay, on hill (Blatter & McCann 2829 !); Parsik Hill (Blatter & McCann 2360 !); Uran, Bombay Harbour (Hallberg & McCann 2735 ! 3198 !); Thana (Herb. St. X. C. 3101 !); Bassein (Chibber !); Kalyan (H.E.B.B. !); Jutara, Bandra (Ryan 1344 !); Borivli (Chibber !); Thana to Kalyan (Herb. Woodrow !).—*N. Kanara*: Hattikeri, Karwar, rocky hillside (Herb. Sedgwick & Bell 6772 !, Hallberg & McCann C16 !); Sulgeri (Bell 4262 !); Yellapur (Talbot 980 !); Karwar (Talbot !).

Flowering & fruiting: January 1917 (Igatpuri, Uran); July 1917 (Khandala); August 1896 (Khandala, Kalyan); August 1887 (Karwar); August 1918 (Sulgeri); August 10th, 1884 (Yellapur); September 1917 (Trombay, Igatpuri); September 1919 (Thana); September 10th, 1884 (Yellapur); September 10th, 1912 (Borivli); September 18th (Khandala); September 20th, 1902 (Khandala); September 28th, 1903 (Jutara); October 1909 (Castle Rock); October 1917 (Igatpuri); October 1919 (Karwar, Hattikeri); October 8th, 1907 (Lonavla); October 14th, 1909 (Lonavla); October 27th, 1902 (Castle Rock); November 1919 (Trombay).

Field notes: A purely monsoon species confined to open grassland where the grasses are not too tall. Frequently forming pure formations, but generally mixed with grasses and other *Cyperaceae*. When in tall species of grasses it is soon lost; but as the plant commences to flower at the end of July, before the grasses attain to any great height, it does not suffer. In August the nuts are mature, but the plants remain standing till the dry weather.

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This species is easily recognised by its rusty-brown head looking at first sight like a Composite.

Distribution: Bombay Pres., Mysore and W. Coast of Madras Pres.—Cochin-China.

2. **Rhyncospora corymbosa** Dom. in Biblioth. Bot. lxxxv (1915) 468.—*R. aurea* Vahl Enum. ii (1806) 229; Cke. ii, 901.—*Scirpus corymbosus* Linn. Amoen. Acad. iv, 303.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 670.

Description: Cke. l.c.

Locality: *W. Ghats*: Castle Rock (Herb. Sedgwick & Bell 5536 !, McCann C18 ! C19 !).—*S. M. Country*: (Young ex Woodrow ex Cooke).—*N. Kanara*: Gersoppa Falls, 1,400 ft., rainfall 200 in. (Herb. Sedgwick & Bell 7954 !, Hallberg & McCann C12 !); Anmod, in rice fields, 2,000 ft., rainfall 200 in. (Sedgwick 3280 !); Ekamli (Gammie 13834 !); Yellapur, bank of river (Talbot 1028 ! 1045 !).

Flowering & fruiting: March 1919 (Castle Rock); April 22nd, 1900 (Ekamli); September 1884 (Yellapur); September 20th, 1884 (Yellapur); October 1919 (Gersoppa Falls); December 1917 (Anmod).

Field notes: A plant of heavy rain forest.

Distribution: Throughout India, except the N.-W.—Ceylon, warm regions of the globe.

15. Schoenus Linn. (partim).

Spikelets capitate or panicled; flowers axillary. Glumes (except the uppermost tabescent) distichous; 3 (or more) lowest empty, 1-4 following perfect, nut-bearing, somewhat remote. Hypogynous bristles often present, setaceous, not dilated at base. Stamens 3, anterior. Style 3-fid, gradually passing into the nut without any construction below style-base. Nut in a hollow of the zigzag persistent rhachilla, trigonous.—Species 70.—Australia, New Zealand, a few in Malaya, America, Europe.

1. **Schoenus nigricans** Linn. Sp. Pl. 64; C. B. Clarke in Hook. f. F.B.I. vi, 673.

Description: Almost glabrous. Rhizome horizontal, woody; stolons 0. Stems 10-60 cm., subterete, without nodes except near base. Leaves 10-30 cm., often half stem, very narrow with incurved margins. Spikelets 1-15, almost capitate, 3-13 mm. long, in a close distinctly compound head; lowest bract suberect, often 2.5-10 cm. Hypogynous bristles $\frac{1}{3}$-$\frac{1}{2}$ nut or nearly obsolete. Glumes ovate, obtuse, microscopically hispid on keel, chestnut or brown; 3 lowest empty, 1-3 next nut-bearing; style 3-fid. Nut sessile, ovoid, ellipsoid, marble-white, 1.2 mm., top acutely pyramidal.

Locality: *Sind*: (Pinwill ex Clarke).

Distribution: Kuram Valley, Sind, Punjab.—Nearly cosmopolitan, except S.E. Asia and Australia.

16. Remirea Aublet (Cke. ii, 902).

Species 1.—Tropics.

1. **Remirea maritima** Aubl. Hist. Pl. Guian. i (1775) 45, t. 16; Cke. ii, 902.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 677.

Description: Cke. l.c.

Locality: *N. Kanara*: (Thomson ex Cooke); Karwar, sandy shore (Hallberg & McCann C1 !, Sedgwick 5083 ! 6677 !); Honavar, sandy shore (McCann C4 !); sandy shore at Sidceshyagud (label illegible), near Karwar (Talbot 552 !).

Flowering & fruiting: August 1st, 1883 (Sidceshyagud, near Karwar); October 1919 (Karwar); December 1921 (Honavar).

Field notes: Purely a sandy shore species almost within tidal limits. Being the only species it is easily recognizable by its very stiff leaves and compact heads. Very common at Karwar and Honavar. It produces long creeping stolons giving off aërial shoots at intervals.

Distribution: Seacoasts in India.—Ceylon, most tropical seacoasts.

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17. HYPOLYTRUM L. C. Rich. (Cke. ii, 899).

Species 40.—Tropics and subtropics.

1. **Hypolytrum latifolium** L. C. Rich. in Pers. Syn. i, 70; C. B. Clarke in Hook. f. F.B.I. vi, 678; Fischer Fl. Madras 1673.—*H. Wightianum* Boeck. in Linnaea xxxvii (1871) 130; Cke. ii, 899.

Description: Stem 0.6-0.9 m. high, trigonous. Leaves sometimes longer, acuminate, base narrowed, 1.3-2 cm. wide, margins and midrib below spinulose, especially near the apex; bracts like the leaves, up to 43 cm. long. Spikes sessile or pedunculate in compound corymbose or contracted panicles, oblong-cylindric in flower, sub-globose and lobed in fruit, 5-6.5 mm. long. Empty glume brown with darker dots, oblong or obovate, rounded or subacute, 1.75-3 mm. long, slightly concave, keeled, rigid, male glumes complicate, narrowly boat-shaped or oblanceolate, acute or subacute, 1.25-3 mm. long, membranous or hyaline, keel brownish and more or less ciliate, appressed to the ripe nut; intercalated glumes 0. Nut either fusiform and acuminate, or broadly ovoid, acute or cuspidate, base narrowed or rounded, turgidly biconvex or nearly terete, 2.5-3.5 mm. long, including the inconspicuous or large and patent sometimes swollen beak which is often longer than the nut itself and as broad or broader, often pale and speckled with brown; nut brown, smooth or rugose, sometimes empty.

Locality: *W. Ghats*: Castle Rock (Chibber !, Bhide !, Kanitkar ex Cooke).—*N. Kanara*: (Dalzell ex Cooke); Arbail Ghat, 2,000 ft., rainfall 200 in. (Sedgwick 5124 !); Anmod, watercourse in evergreen (Sedgwick 3239 !); Sampkhand (Hallberg & McCann C5 !); Gersoppa Falls (Talbot 1075 !); Mysore side (Hallberg & McCann C6 !); Gersoppa Road (Chibber !); Yellapur, common in some evergreen near (Talbot 1075 !); Dodmune (Talbot 3596 !); Katgal (Woodrow ex Cooke).

Flowering & fruiting: March 7th, 1896 (Dodmune); March 23rd, 1908 (Castle Rock); April 13th, 1909 (Castle Rock); May 11th, 1911 (Gersoppa Falls); October 1919 (Gersoppa Falls); November 18th, 1884 (Gersoppa Falls); December 1917 (Anmod); December 1918 (Arbail Ghat).

Distribution: Sikkim and Assam to Singapore, Travancore, Ceylon, Nicobars and Andamans.—Malaya, China, Australia, Polynesia.

18. SCLERIA Berg. (Cke. ii, 902).

Plants of open grassland and forests. Those that appear in open places are generally monsoon species, but those in evergreen tracts flourish throughout the year.—Species 160.—Tropics.

Cooke has 6 species. We consider *S. biflora* Roxb. as a variety of *S. tessellata*. The following are new to the Presidency: *S. corymbosa*, *S. poaeformis* and *S. cochinchinensis*.

Key

A. Annuals. Rhizome 0 or very small ... 1. *S. tessellata.*
B. Perennials with woody rhizome
I. Disk obsolete. Nut smooth
1. Spikelets in small clusters on a filiform rhachis ... ... 2. *S. lithosperma.*
2. Spikelets very many, clustered ... 3. *S. corymbosa.*
II. Disk 3-lobed
1. Nut smooth
a. Panicle with many capillary bracteoles 4. *S. hebecarpa.*
b. Panicle with few or no capillary bracteoles ... ... 5. *S. poaeformis.*
2. Nut reticulate ... ... 6. *S. cochinchinensis.*
III. Disk cupular ... ... 7. *S. annularis.*
IV. Disk 3-6-lobed. Nut cancellately sculptured 8. *S. Stocksiana.*

1. **Scleria tessellata** Willd. Sp. Pl. iv (1805) 315; Cke. ii, 903.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 686.
Description: Cke. l.c.

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Locality: *Konkan*: Near Panvel (Jacquemont ex Cooke).
Distribution: Throughout India except the W. arid area.—Ceylon, Malaya, China, Japan, Australia.

Scleria tessellata Willd. var. **biflora** (Roxb.) Blatter *et* McCann *comb. nov.* —*S. biflora* Roxb. Fl. Ind. iii (1832) 573; C. B. Clarke in Hook. f. F.B.I. vi, 687; Cke. ii, 904.
Description: Cke. l.c.
We have made *S. biflora* Roxb. a variety of *S. tessellata* to which it is intimately allied. The leaves are broader, the disk-lobes are larger, and the nut is beaked. But otherwise it is hardly distinguishable.
Locality: *Konkan*: (Woodrow 77 ex Cooke); Foot of hills W. of Mulland, in shade of bushes (McCann 799 ! 893 ! 1268 ! 1269 ! 1282 !); Mulgaum (Blatter & McCann 3661 !, Herb. Sedgwick 3570 !); hills near Matheran (Kantekar !).—*N. Kanara*: Karwar (Talbot !), on pathway (Sedgwick 6626 !), on broken ground on hillside (Sedgwick 6590 !); Ainshi Ghat (Talbot 1506 !).
Flowering & fruiting: July 1919 (Mulgaum); August 11th, 1929 (Hills W. of Mulland); August 12th, 1885 (Ainshi Ghat); August 25th, 1885 (Karwar); September 2nd, 1890 (Hills near Matheran); September 22nd, 1929 (Hills W. of Mulland); October 1919 (Karwar).
Field notes: A monsoon species appearing in July in open places. A curious fact is that it usually grows near bushes, not under, by which it is sheltered from the morning sun. The hairs on the nut are at first white but become ferruginous with age. The stems are erect or decumbent with sharp angles.
Distribution: N. and E. Bengal, Cachar, Konkan, N. Kanara.—Ceylon, Malaya, S. China.

2. **Scleria lithosperma** Sw. Prodr. (1788) 18; Cke. ii, 903.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 685.
Description: Cke. l.c.
Locality: *Konkan*: Hills above Kanari Caves, 1,400 ft., Salsette Isl. (Blatter & McCann 28637 !).—*W. Ghats*: Matheran (Woodrow ex Cooke).—*N. Kanara*: Karwar (Talbot 526 !), in forest on hillside by sea, very abundant (Sedgwick 6511 !), coast forest (Sedgwick 5069 !, Hallberg & McCann C33 !); Guddehulli, Karwar (Sedgwick 6531 !).
Flowering & fruiting: July 10th, 1883 (Karwar); October 1919 (Karwar, Guddehulli); November 1918 (Kanari Caves).
Field notes: Purely a forest species—evergreen forests, growing in dense tussocks. It is easily distinguished from *S. hebecarpa*, which it closely resembles, by its lax inflorescence. It grows all the year round but is not always in flower. Quite common in the higher hills of Salsette where there is evergreen.
Distribution: Throughout India, except the W. arid area, up to 4,000 ft., from Sikkim to Ceylon and Malacca, Andamans and Nicobars.—All warm regions except Continental Africa.

3. **Scleria corymbosa** Roxb. Fl. Ind. iii (1832) 574; C. B. Clarke in Hook. f. F.B.I. vi, 686.—*Ibidem* synonyms.
Description: A stout robust plant, nearly glabrous; culms 0.6-2.4 m. tall. Leaves 30-50 cm. long, 1.3-2.5 cm. wide; sheaths angled or strongly winged. Panicle 45-60 cm. long, of 6 or 7 compound corymbose axillary panicles 7.5 cm. long. Bracts setaceous. Spikelets 6 mm. long, nearly all bisexual. Glumes greenish, pale. Nut ellipsoid, acute at both ends, smooth, white 3 mm. long. Disc small, brown, obscurely 3-lobed.
Locality: *S. M. Country*: Belgaum (Ritchie 869 part ex Clarke).
Distribution: Warm moist region of India, sparsely scattered from Khasia Terai to Ceylon and Malacca; S. M. Country, Rampa Dist., Godavari, Chingleput, Malabar Districts, Travancore.

4. **Scleria hebecarpa** Ness in Linnaea ix (1835) 303; Cke, ii, 904.—Synonyms in C. B. Clarke in Hook. f. F.B.I. vi, 689.
Description: Cke. l.c.

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Locality: *Konkan*: (Stocks, Law ex Cooke); Okde Forest, Thana Dist. (Ryan 716 !).—*N. Kanara*: Karwar, coastal forests (Sedgwick 5068 !, Hallberg & McCann C34 !), in forest on hillside by sea, abundant (Sedgwick 6515 !); Gersoppa Falls, 1,400 ft., rainfall 200 in. (Herb. Sedgwick & Bell 7176 !); Sulgeri, 500 ft., rainfall 200 in. (Bell 4261 !); Tinai Ghat (Gammie 15818 !).

Flowering & fruiting: August 1918 (Sulgeri); October 1919 (Karwar, Gersoppa Falls); October 22nd, 1902 (Okde Forest); November 1st, 1902 (Tinai Ghat); December 1918 (Karwar).

Distribution: Throughout India except the N.-W. arid region.—Ceylon, Malaya, China, Japan, Australia, Polynesia.

5. **Scleria poaeformis** Retz. Obs. iv, 13; Fischer Fl. Madras 1679.—*S. oryzoides* Presl. Rel. Haenk. i, 201; C. B. Clarke in Hook. f. F.B.I. vi, 691.—*Ibidem* synonyms.

Description: Glabrous, robust. Stolons elongate, 8 mm. diam., without scales, probably floating. Stems 0.9-1.8 m. long, stout; sheaths 3-winged. Leaves 0.9 m. by 1.7 cm., or the upper 25 cm. by more than 2.5 cm. Panicle apparently terminal without bracts (a small axillary remote one rarely added), 15 by 7.5 cm., dense with innumerable branches and spikelets; usually the upper spikelets on the branches are male, a few of the lower female. Spikelets 6 mm. long, oblong, sessile, a rich brown. Nut 3 mm. diam., subglobose, smooth, white; disc obpyramidal, truncated, with a narrow, rusty brown rim, hardly 3-lobed.

Locality: *N. Kanara*: Birchy (Talbot 1694 !); Tatwal (Talbot 1907 !).

Flowering & fruiting: May 10th, 1888 (Birchy); August 15th, 1889 (Tatwal).

Distribution: S.-E. India, from Assam to Ceylon and Malacca.—Tropical Africa, Malaya, Philippines, Australia.

6. **Scleria cochinchinensis** Druce in Rep. Bot. Exch. Cl. Brit. Isles 1916 (1917) 646; Fischer Fl. Madras 1678.—*S. elata* Thw. Enum. 353.—*Diaphora cochinchinensis* Lour. Fl. Cochinch. 709.—*S. melanostoma* Boeck. in Linnaea xxxviii, 514.—For synonyms see C. B. Clarke in Hook. f. F.B.I. vi, 690 and 692.

Description: A perennial with woody rhizome. Stem stout, sharply trigonous, angles scabrid, up to 1.8 m. high, glabrous. Leaves up to 60 cm. long and 17 mm. wide; sheaths sharply trigonous, those of the midstem often winged, mouth with a short, rounded, coriaceous ligule. Spikelets sessile or peduncled, subsolitary in large, long-peduncled, decompound panicles, 3.5 mm. long. Nuts reticulate, globose or broadly ellipsoid, obtuse or apiculate, 2.5-4 mm. long, white, pale- or dark-brown, sometimes purplish-brown; disk lobes 3, short, rounded.

The specimen obtained by McCann at Castle Rock was about 6 m. high, double the size given by Hooker even for the Var.

Locality: *W. Ghats*: Castle Rock, 1,600 ft., rainfall 250 in. (Sedgwick 2765 !, McCann C32 !, Bhide !, Gammie 15639 !).—*N. Kanara*: Sampkhand, 1,600 ft., rainfall 200 in. (Sedgwick 6970 !, Hallberg & McCann C29 !); Gersoppa Falls (Talbot 2669 !).

Flowering & fruiting: March 1919 (Castle Rock); April 13th, 1909 (Castle Rock); August 1917 (Castle Rock); October 1919 (Sampkhand); October 25th, 1902 (Castle Rock); December 28th, 1891 (Gersoppa Falls).

Field notes: A species of the evergreen forest in the heavy rainfall tracts.

Distribution: Throughout India except the N.-W. arid regions, up to 2,000 ft.—Ceylon, Java, China.

7. **Scleria annularis** Kunth Enum. ii (1837) 359; Cke. ii, 903.

Description: Cke. l.c.

Locality: *Konkan*: (Stocks, Law ex Cooke); Satiwali, Bassein (Ryan 1437 !).—*N. Kanara*: (Law ex Cooke).

Flowering & fruiting: September 21st, 1903 (Satiwali).

Distribution: N.-W. India, Central India, Konkan, N. Kanara, Malabar.—China.

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8. **Scleria Stocksiana** Boeck. in Linnaea xxxviii (1874) 474; Cke. ii, 905.

Description: Cke. l.c.

Sedgwick in his paper on the *Cyperaceae* of the Bombay Presidency refers to a form from the red laterite of Talod. We have examined this particular specimen and found the nut cancellate. Though, as Sedgwick remarks, the usual form of the nut is corrugose, we have found that in the same plant the nuts may vary from the common corrugose texture to the cancellate form.

Locality: Without locality (Dalzell !).—*Gujarat*: Talod, red earth upland (Sedgwick 252 !).—*W. Ghats*: Igatpuri (Blatter & Hallberg 2813 !); Khandala, The Saddle (Blatter & McCann 27593 !); Panchgani, Tableland (Blatter 3796 !, Sedgwick 7597 ! 7670 !), below Third Tableland (McCann !); Londa (Woodrow ex Cooke).—*Deccan*: Talegaon (H.E.B.B. !).—*Konkan*: (Stocks, Law ex Cooke).—*S. M. Country*: Tadas, Dharwar Dist., 2,500 ft., rainfall 35 in. (Sedgwick 1909); Dharwar, in a marsh, 2,400 ft., rainfall 34 in. (Sedgwick 6613 !); Bidi, Belgaum Dist., 2,500 ft., rainfall 60 in. (Sedgwick 2976 !); Devarayi, 1,800 ft., rainfall 90 in. (Sedgwick 4476 !).—*N. Kanara*: (Woodrow ex Cooke); Haliyal (Talbot 2066 !); Kilgerry (Talbot 2615 !).

Flowering & fruiting: August 1914 (Talod); August 15th, 1891 (Kilgerry); September 1917 (Igatpuri, Bidi); September 27th, 1895 (Talegaon); October 1918 (Khandala, Devarayi); October 1920 (Panchgani); October 6th (Panchgani); October 10th, 1888 (Haliyal); November 1916 (Tadas); November 20th, 1889 (Haliyal).

Field notes: A plant of marshy soil. We have noticed that it usually grows in the shade of vegetation, protected from the morning sun.

Distribution: Endemic in the Bombay Presidency.

19. Diplacrum R. Br. (not in Cke.).

Small, tufted, glabrous, annual herbs. Stems leafy throughout. Spikelets very small in small, dense terminal and axillary clusters at the mouth of the leaf-sheaths, 1-sexual; male 3-4 at the base, 1-2-flowered with about 3 glumes, stamens 1-2; female terminal, 1-flowered with 2 opposite glumes. Style slender; stigmas 3. Nut globose or nearly so.—Species 3.—Tropics.

1. **Diplacrum caricinum** R. Br. Prodr. 241.—*Scleria caricina* Benth. Fl. Austral. vii, 426; C. B. Clarke in Hook. f. F.B.I. vi, 688.—*Ibidem* synonyms.

Description: Stems slender, 2.5-35 cm. high, clothed with the leaf-sheaths. Leaves linear, flat, 1.3-7.5 cm. long; bracts short, lanceolate, margins minutely scabrid. Clusters of spikelets small; spikelets minute, male 3-5 at the base, 1.25-1.5 cm. long, glumes 3-4, membranous or hyaline, brownish, female narrowly ovate; glumes 2, slightly united at the base and falling with the nut from the minute knobbed pedicel, coriaceous, ribbed, 1.75 cm. long, 3-cuspidate; lobes acuminate, midlobe longest, lateral lobes and part of the margins sometimes hyaline. Nut nearly globose, minutely apiculate, 1.25 mm. long, whitish or pale brown, strongly 15-ribbed, the ribs sometimes anastomosing.

Locality: *N. Kanara*: Siddhapur, grassland (Sedgwick 7019 !); Gersoppa Falls, on sand, 1,400 ft., rainfall 200 in. (Sedgwick 7147 !, Hallberg & McCann C25 !); Sirsi, grassland, 1,800 ft., rainfall 100 in. (Sedgwick 7001 !); to Sirsi (Hallberg & McCann C26 !); Sirsi to Siddhapur (Hallberg & McCann C28 !); Yellapur (Talbot 3 sheets !).

Flowering & fruiting: August 20th, 1884 (Yellapur); September 1884 (Yellapur); October 1919 (to Sirsi, Sirsi, Gersoppa Falls, Sirsi to Siddhapur, Siddhapur); October 25th, 1883 (Yellapur).

Distribution: From the Sikkim Terai and Assam to Ceylon and Tenasserim, N. Kanara.—Malaya, China, Australia.

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WHERE BIG GAME 'TAKE THE WATERS'.[1]

A Hidden Watcher at a Burmese 'Salt-lick'.

BY

E. H. Peacock.

(*With* 3 *plates*).

There can be few places more likely to appeal to the lover of Nature than a secluded 'salt-lick' in some remote forest of Burma. Situated, generally, in a small clearing near some lonely forest stream, among rugged tree-clad hills these 'licks' are very often possessed of a charming scenic value besides being the haunt of a variety of wild animals and birds.

'Salt-licks' may take the form of earth banks or springs of water impregnated with mineral salts, sulphur springs, hot springs or those peculiar mud-volcanoes formed by the upheaval of decomposed volcanic rock by the pressure of gases escaping from below.

Ye-ngan, sa-dwin, chit, chit-ngan, the Burmese call these natural dispensaries from which the wild animals of the forest obtain the salts and sulphates that they know, instinctively, to be so beneficial to their health. So strong is this instinct and the amount of impregnated earth consumed so great that the animal droppings found near some of the 'dry-licks' are often composed almost wholly of mud.

The carnivora are only less eager than the deer, bison and *saing* to avail themselves of the tonic properties of the 'licks', and the trees surrounding well-situated 'wet-licks' in glades or clearings are often covered by flocks of green pigeons and other birds waiting for a safe moment in which to venture on to the ground and sip the waters of these healing springs.

Some natural law appears to protect the game at these 'licks' from ambuscade by the carnivora; at least I like to think so. I have never seen or heard of a 'kill' at, or very near, a 'salt-lick'. Men, however, are not to be so governed, and a 'lick' is generally the favourite resort of the poacher and, too frequently, some so-called sportsmen. The magnitude of the offence is appreciated and given expression to by the game laws; but surely such depravity deserves an even higher penalty than is generally imposed on the ordinary poacher.

When a 'salt-lick' is situated in very remote and secluded forests, wild animals will frequently emerge in the day-time. No more interesting scene for the work of the nature photographer can be imagined than a well-situated 'lick'.

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[1] By courtesy of *the Field*.

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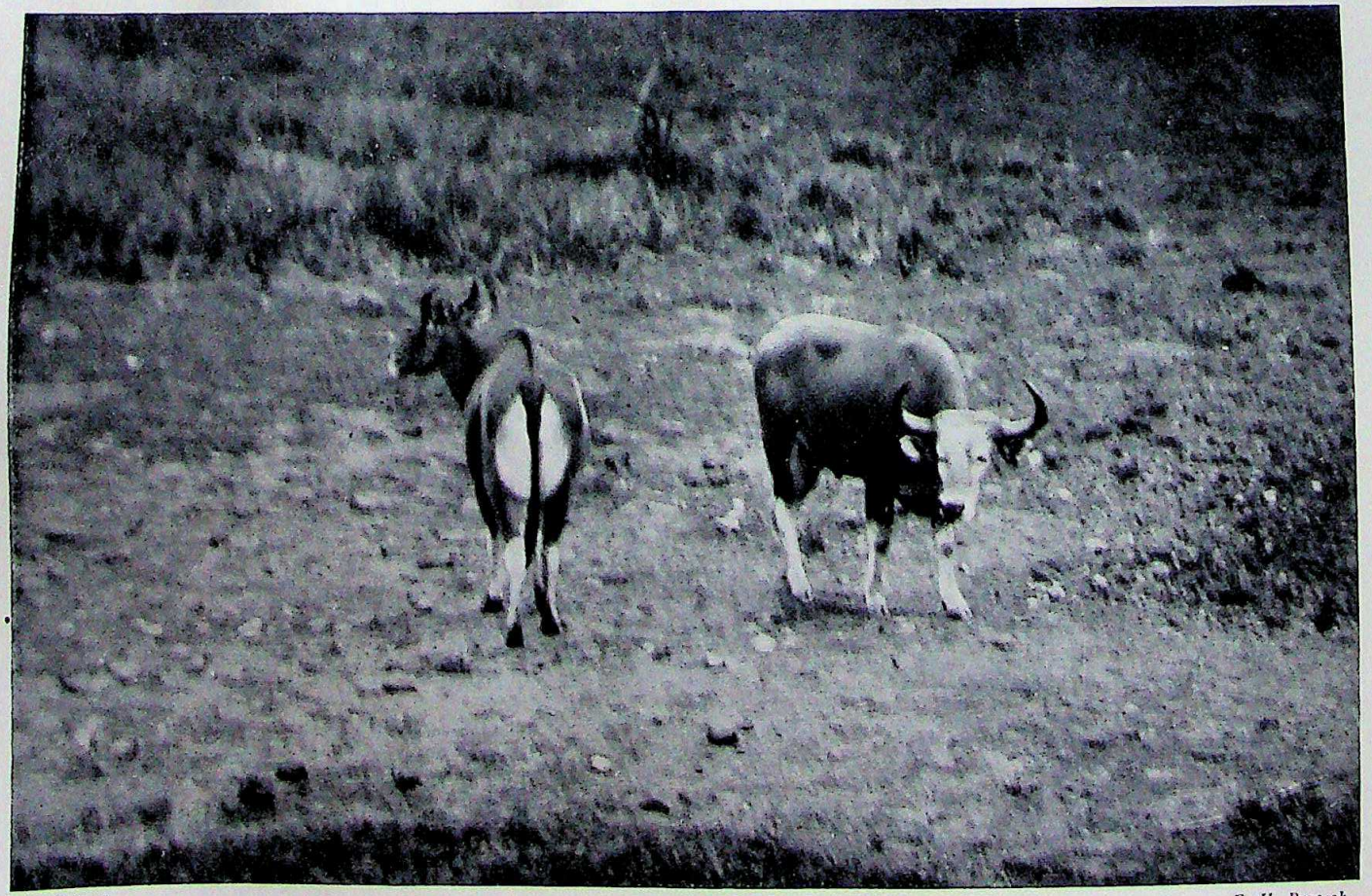

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A young bull and cow Saing (*Bibos banteng*, Lyd.) came embarrassingly close to our 'hide.'

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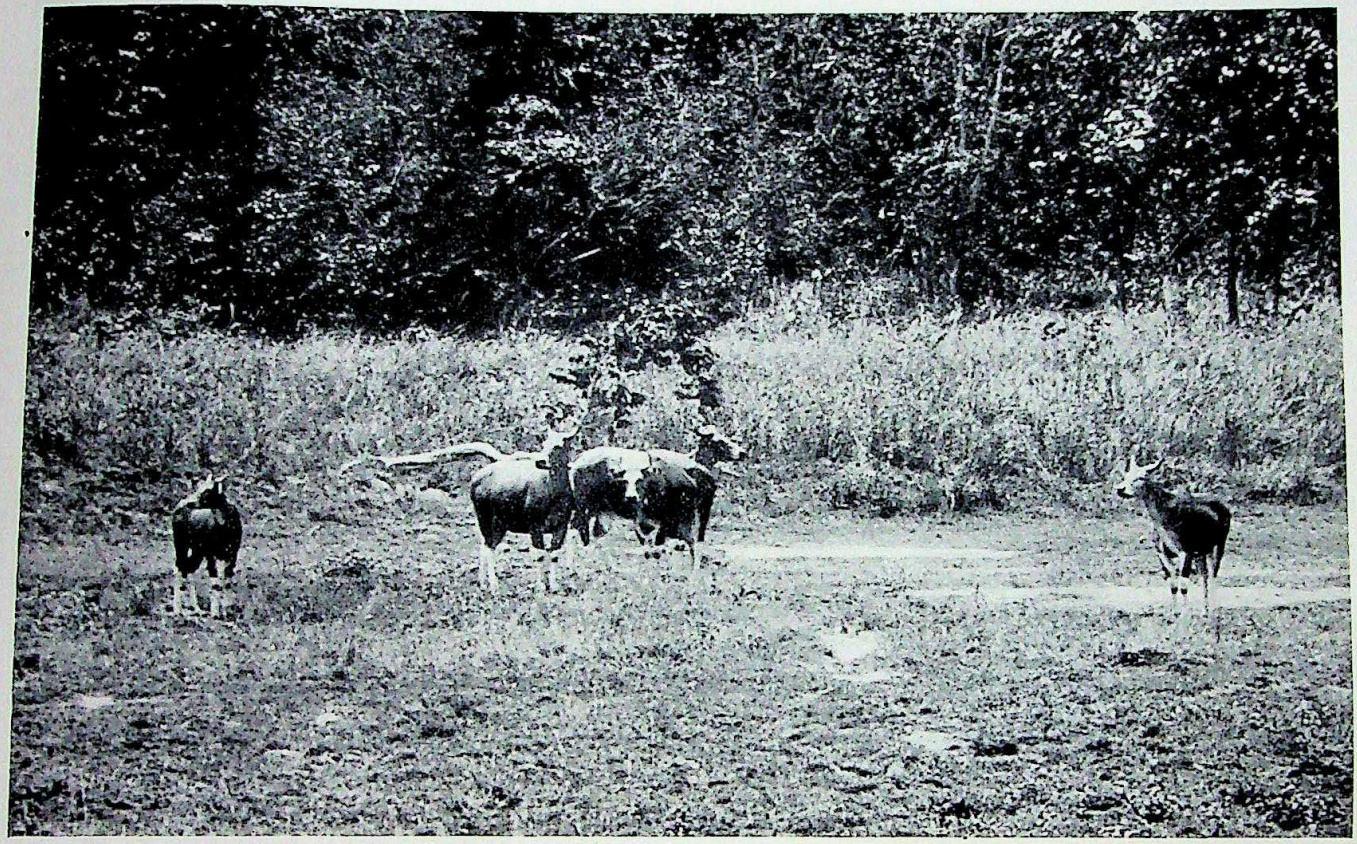

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A herd of Saing (*B. banteng*, Lyd.) cows stood staring about them in perplexity and alarm.

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Compared with the pastime of tracking or still-hunting for game, the practice of lying in wait with a camera near a 'salt-lick' is a comparatively sedentary sport; nevertheless, it is a delightful one and a welcome change from more strenuous pursuits.

There was a 'wet-lick' which we knew as the *Kason-chit* near which I had spent many fruitless hours in spite of the tracks indicating that it was frequently visited by bison, *saing*, sambur, hog-deer and barking-deer. On each occasion when I had watched over this 'lick', approaching game had crossed my tracks or an irritatingly changeable wind had made known my presence. Came a day, however, when Nature was kind and I obtained a mixed bag of photographs that recalls many pleasant memories.

The luck of this day was evident early in the morning as we were settling down to a five-mile tramp to the 'lick'. There had been rain during the night and the wet grass on the *lwins* was shimmering in waves of green and silver under the breath of the dawn-wind and a rising sun. It wanted some hours before the growing heat should bathe us in an uncomfortable bath of perspiration, and I found very little wrong with the world this pleasant morning. We followed a game path through a belt of woods and were about to cross a narrow *lwin* of short grass, when I spied a bison cow feeding near the skirts of the forest and, in the woods behind her, the dark shapes of a number of her companions.

The light had grown strong enough to dispense with a tripod and time exposures, so I made a quick stalk and, by good fortune, obtained a close photograph of this cow with her head down in the act of grazing. But some of the herd, which was on its way to its day-time lair in the forest, detected my presence and snorted. The cow near me promptly threw up her head and tail and turned to bolt. One more exposure I made while she was in this position and then they had all gone.

Feeling well pleased at this good start, I rejoined my men and, after still-hunting quietly through the intervening forests and *lwins*, we arrived at the *Kason-chit* before ten o'clock. Here we made a small 'hide' of leafy branches and, with a novel and a comfortable seat of leaves and grass, prepared to pass an enjoyable slack day.

I was engrossed in a thrilling drama of 'murder, mystery and love', when Maung Po Hte's rude tug at my sleeve brought me back to a world of facts.

'Daye'—hog-deer—he said, and stooped to look through a hole in the leafy wall of our hide.

An Elephant Pays a Call.

They were only two shy little hinds that walked mincingly to a pool of water on our left and, after many anxious glances around them, drank slowly. They would not cross the clearing and, after I had made a few long-range exposures, they walked quietly back into the long grass from which they had come.

When these hog-deer had gone, I went back into the world of Edgar Wallace; but it was not long before a loud crashing noise behind us brought me to my feet with the unpleasant conviction

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that a herd of wild elephants was close beside us. But it was only a young bull elephant that crashed carelessly down to the pool, got our wind and made an undignified retreat before ever I could get my camera aligned.

At mid-day we had food, and I tried to photograph the monkeys, hornbills and green pigeons perched on the trees upwind of our hide. Mostly I failed, but now and again I would make a few doubtful exposures.

The wanderer in these hills must carry away with him the memory of two sounds more frequently heard and insistent than others; the plaintive cooing of the green pigeons and the wonderfully clear, loud and varied scale of notes produced by the gibbons. White-browed in the north, white-handed in the south, these little tailless apes are ever within hearing, but most difficult to approach and photograph, unless one is prepared to give more time to their pursuit than is usually available. Yet there are few more attractive creatures to observe.

We had arranged to leave the 'lick' and still-hunt on the homeward route from about four or five o'clock in the evening; but it was very nearly four o'clock before any large game appeared at the 'lick'. I was becoming restless and tired of sitting still, when a slight noise on the opposite side of the clearing attracted my attention. I pressed my face close to a small gap in the leafy wall of our 'hide' and saw, to my delight, that a herd of *saing* had approached the 'lick' and that two or three cows had already walked out of the forest and into the clearing. A young bull and a cow *saing* came embarrassingly close to our 'hide'; the others spread themselves over the clearing and nibbled at the short grass at a range of about 40 to 60 yards. The wind was favourable, but, with two *saing* within 20 yards of our 'hide', I dared not make any but the gentlest movements.

I made two or three exposures on the young bull and cow near me, and was congratulating myself on this opportunity when some movement on my part, or instinct on theirs, warned the animals near me of my presence. They grew restless and walked off stiffly, their heads up and their eyes ready to catch the first sign of danger.

The alarm was communicated to the other members of the herd, which ran together and stood staring about them in perplexity and alarm. I made three or four exposures on this herd before they eventually made up their minds that something was definitely wrong and moved off into the woods.

I calculated that I had obtained one, if not two, good negatives of a bison cow, one of hog-deer and half a dozen of the *saing* herd —not to mention odds and ends of photos of birds and monkeys. I felt pleased and happy as we packed our few goods and left the 'hide' for our return journey.

I was carrying the camera, with tripod attached, over my arm and had just moved out of the 'hide' to one side of the clearing when I saw, within 20 yards, a sambur stag staring at me in wide-eyed horror. The surprise was mutual and, of course, before I could bring my camera to bear, he had gone like a wraith. What

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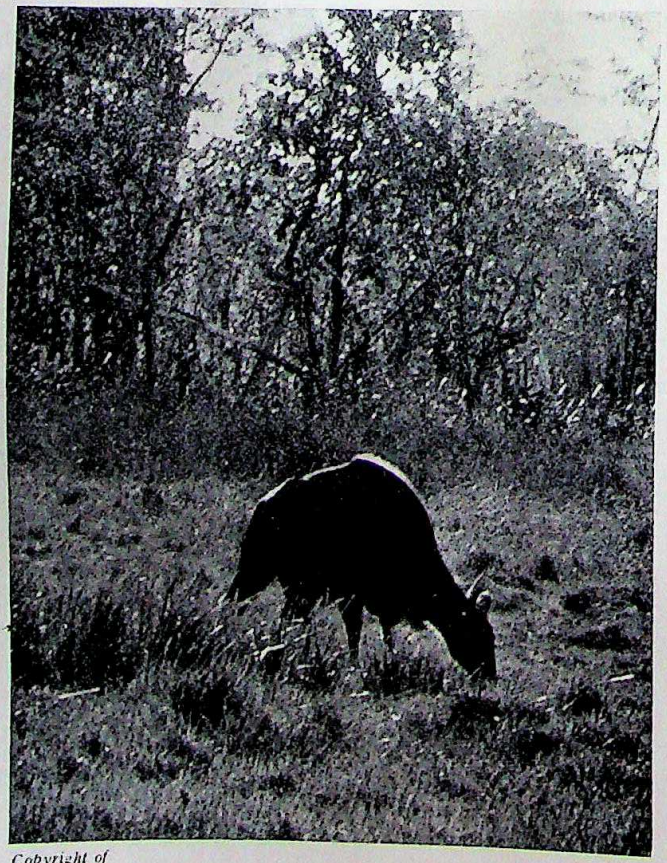

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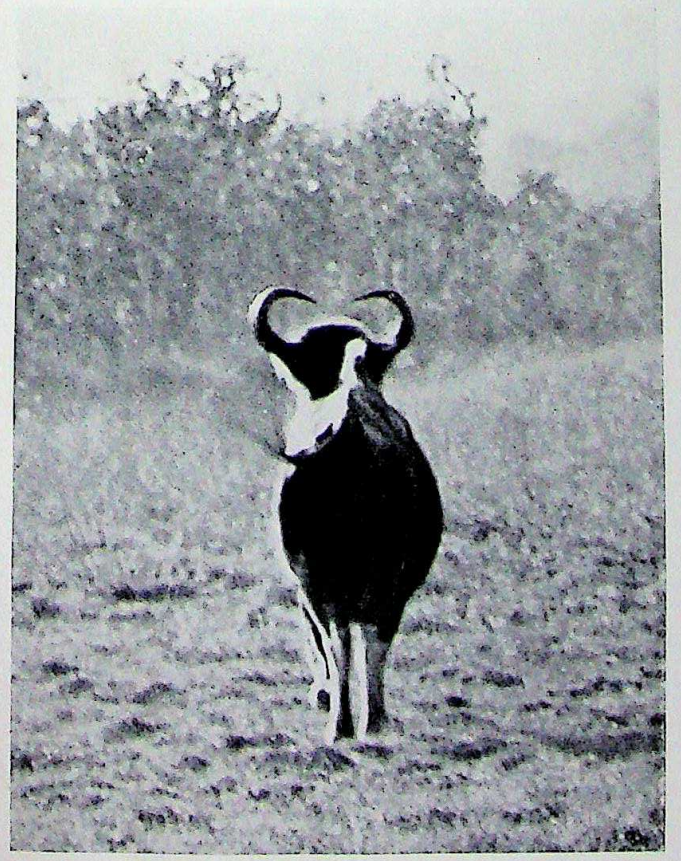
A cow Bison (*B. gaurus*, H. Sm.) feeding near the skirts of the forest.



E. H. Peacock.

"She promptly threw up her head and tail and turned to bolt."

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an opportunity to have lost! If only I had remained in the 'hide' for five more minutes he would probably have walked out into open view! These 'ifs'!

So home we went, feeling a bit depressed about that lost opportunity; hoping for something to occur which might soften the memory of that fine stag standing within 20 yards of us. And the hope was not altogether vain, for, just before the light began to fade, I saw three sambur hinds on a grass-covered knoll and made a close, though not entirely unobserved approach.

With them it was a case of tail up and ears up and: 'Who the devil are you?' a sharp stamping of feet, a resounding 'tit' and the clatter of hoofs as they bolted for the cover of the woods. And that was the last memory I hold of a day at the *Kason-chit;* but some photos remain, otherwise how shall 'the years which the locusts have eaten' be restored to us?

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ON A COLLECTION OF FISH FROM AFGHANISTAN.

BY

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(With a plate and 4 text-figures)

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In 1933, in the *Journal* of the Society an account was given of the fish of Afghanistan (vol. xxxvi, No. 3, pp. 688-706, 2 pls. and 2 text-figs.) and a small collection of five specimens was dealt with. During 1933, Sir Richard Maconachie, Major A. E. Farwell and Capt. E. W. Fletcher sent further material from Afghanistan to the Bombay Natural History Society which was kindly forwarded to me by Mr. S. H. Prater for examination and report. I am deeply indebted to these gentlemen for affording me an opportunity to report on a very valuable collection which has helped greatly in understanding the precise specific limits of a number of McClelland's hitherto ill-defined species from this country. Sufficient stress cannot be laid on the fact that, with the increased knowledge of the ichthyology of Afghanistan, the taxonomy and geographical distribution of the Central Asiatic fishes will become clear, and it will then be possible to standardise the classification of the fishes of this vast region.

The collection reported below was made at different places in all the three main river basins of Afghanistan: namely, those of the Kabul, the Helmand and the Oxus. At my request the collectors have supplied short ecological notes on the various localities in which the fish were collected and I propose to give below a list of these stations with the names of species collected therefrom.

KABUL SYSTEM.

1. *Sar-i-Chashma.*—'The head springs of the Kabul river. Bottom stony, water clear and swift. Water cress and such like vegetation on the banks' (Major A. E. Farwell).

i. *Oreinus sinuatus* var. *griffithii* McClell. — 1 specimen.
ii. *Nemachilus griffithii* var. *afghana*, nov. — 4 specimens.

2. *Chahiltran stream.*—'A tributary of the Kabul river about 6 miles west of the Kabul City. The small stream has a pebbly bottom and has water cress and such like vegetation on its banks (Sir R. Maconachie).

i. *Nemachilus griffithii* var. *afghana*, nov. — 1 specimen.

3. *Logar river.*—'Has a muddy bed and somewhat sluggish current. Runs through cultivation,—rice, wheat and barley predominating. No information as to where fish were caught, but believed to be in a pool' (Major A. E. Farwell). The Logar river is a tributary of the Kabul river; it arises in the Gul-Koh on the south

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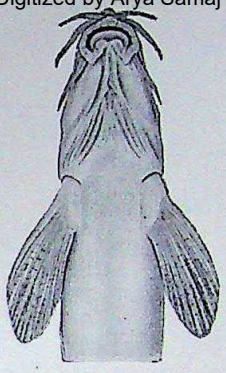

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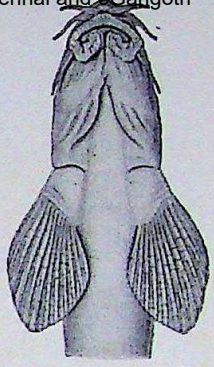

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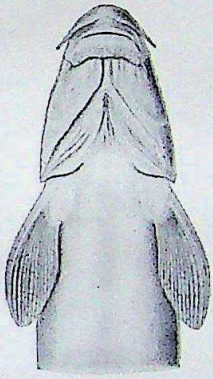

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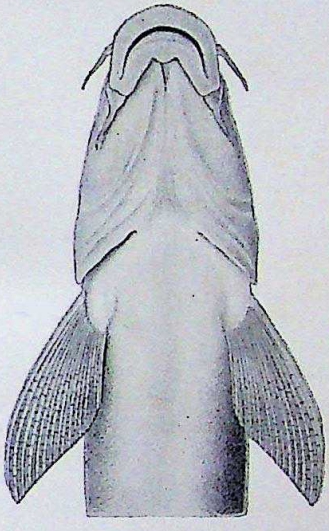

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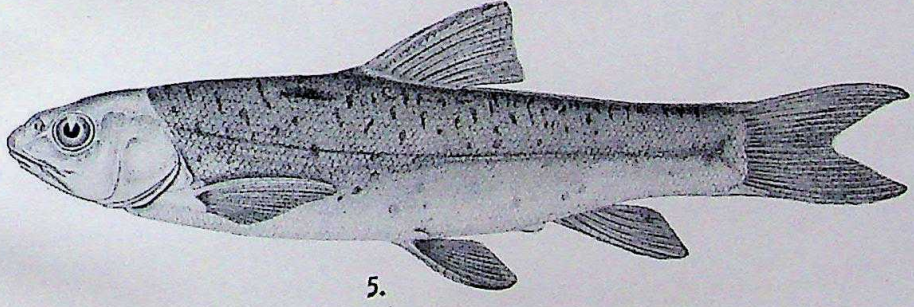

5.

FISHES OF AFGHANISTAN.

Fig. 1.—Ventral surface of head and anterior part of body of a young specimen of *Nemachilus* sp. prox. *griffithii* Günther. ×1 3/5.
Fig. 2.—Ventral surface of head and anterior part of body of the type-specimen of *Nemachilus farwelli*, sp. nov. Nat. size.
Fig. 3.—Ventral surface of head and anterior part of body of *Oreinus sinuatus* var. *griffithii* McClell. ×4/5.
Fig. 4.—Ventral surface of head and anterior part of body of *Schizothorax chrysochlora* (McClell.). ×4/5.
Fig. 5.—Lateral view of *Barbus curito mucocephalus*×*Schizothorax* sp. ×1 1/5.
Fig. 6.—Ventral surface of head and anterior part of body of the above hybrid. ×1 1/5.

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about 70 miles west of Kabul and joins the Kabul river about 10 miles below Kabul City. It has a length of about 200 miles and at its junction is as large as the Kabul river itself.

i. *Schizothorax intermedius* McClell. — 2 specimens.
ii. *Schizothorax chrysochlora* (McClell.). — 2 specimens.

Helmand System.

1. *Helmand river* (no definite locality is indicated).

i. *Nemachilus farwelli*, sp. nov. — 1 specimen.

2. *Sar-i-Bulak stream*.—A tributary of the Helmand river 'approximately 100 miles due west of Kabul as the crow flies. Pebbly bottom, clear water, swift current. Little vegetation but barley and lucerne cultivation in places' (Major A. E. Farwell).

i. *Nemachilus* sp. prox. *griffithii* Günther. — 17 specimens.

Oxus System.

1. *Darra Ashraf* and *Margh streams*.—'Mountain rivers on the north side of Hindukush. Rocky, stony bottoms, clear water and swift current. They join the Bamain river (there known as Surkhab) at Tala which is roughly 85 miles north-west of Kabul as the crow flies' (Major A. E. Farwell).

a. *Darra Ashraf*:—

i. *Salmo trutta aralensis oxianus* Kessler. — 2 specimens.

b. *Margh*:—

i. *Salmo trutta aralensis oxianus* Kessler. — 1 specimen.
ii. *Alburnoides bipunctatus* var. *eichwaldi* (Filippi). — 1 specimen.

2. *Anderab river at Banu*.—The Anderab river 'rises on north-west side of Hindukush at Khawak Pass (35°40′ N., 69°45′ E.). Flows due west through Banu to Doshi (35°40′ N., 68°40′ E.) where it joins Surkhab which flows north into Oxus at about Kudukh Toba (37° N., 68°20′ E.). Bed rocky at Banu with a few deep pools. Current very rapid and water in July was very discoloured owing to irrigation of rice fields which line the banks. Willow fairly numerous along the banks, mulberry trees further inland. The two fish were taken in a small shallow backwater' (Capt. E. W. Fletcher).

i. *Glyptosternum reticulatum* McClell. — 1 specimen.
ii. *Barbus capito conocephalus* × *Schizothorax* sp. (Hybrid). — 1 specimen.

Capt. E. W. Fletcher has kindly supplied the following additional notes on the fish fauna of the Anderab river:—

'Local fishermen catch many "Chush"[1] in this stream with

[1] So far as my information goes, the local name 'Chush' or 'Choosh' is used in Kashmir for *Schizothorax micropogon* Heckel, though Heckel gave 'Ranghursh' as its local name. *Sch. micropogon* is probably not found outside the Kashmir Valley, but it seems likely that in the name 'Chush' Capt. Fletcher makes a reference to a species of *Schizothorax*, of which, unfortunately, he did not collect a specimen. In the fishes collected by him from the Anderab river at Banu, there is a hybrid between a *Barbus* and a *Schizothorax* and it seems likely that both the genera are well represented in the Anderab river.

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mulberries and they also catch trout[1] with slices of "Chush" on a hook. Twelve miles south of Banu lies the Arzu pass from which a small stream of the same name flows north to join the Anderab at Banu. This stream contains no "Chush" but is full of Oxus trout. About 6 miles from Banu it flows through a narrow gorge where there are many rocks. The current here is very swift and trout abound. In July 1933 trout were taken easily on locusts and averaged ½ to ¾ lb., running up to 1½ lb. Only one was taken on a fly. The vegetation consisted chiefly of grass and small scrub bushes, but rice cultivation and willow trees lined the banks up to about 3 miles north of Banu.

'At Khinjan (35°40′ N., 68°50′ E.) the Khinjan River flows into the Anderab from the south. This stream holds "Chush" certainly up to 3 miles from its junction with the Anderab. The vegetation consists chiefly of mulberry trees with some fields near the junction. Higher up, the banks are lined with small bushes and grass. About 14 miles from Khinjan trout were taken on fly in July. They averaged ½ lb. to ¾ lb. and ran up to 1½ lb. The stream was very swift and rocky. There were few locusts to be seen here and, in contradistinction to the Arzu stream, the trout would not look at them.'

It will be seen from the above that the collection dealt with here comprises only 34 specimens belonging to nine species or varieties and a hybrid form. Through the kindness of Dr. C. Tate Regan and Mr. J. R. Norman, a type-specimen of *Nemachilus griffithii* was sent to me for study and I have availed myself of this opportunity to add a few further notes on the species and to give a drawing of the specimen. The specimens from the Paghman river described under this specific name in 1933, as well as those obtained at Sar-i-Chashma and in the Chahiltran stream as noted above, are separated into a new variety *afghana* of *N. griffithii*. A very characteristic new species of *Nemachilus* is described from the Helmand river. *Schizothorax chrysochlora* (McClelland) is described in detail for the first time, and the probable specific limits of *Sch. intermedius* McClelland are indicated. *Oreinus sinuatus* var. *griffithii*, *Alburnoides bipunctatus* var. *eichwaldi*, *Salmo trutta aralensis oxianus*, and *Glyptosternum reticulatum* are recorded from new localities. A full description of a hybrid form between a *Barbus* and a *Schizothorax* is given.

Through the generosity of the Bombay Natural History Society it has been possible to illustrate the paper adequately, and I have great pleasure in offering my sincerest thanks to Mr. S. H. Prater for his kind interest. Mr. R. Bagchi has delineated the fishes under my supervision with his usual skill and care, and my best thanks are due to him for this.

The material is preserved in the collection of the Zoological Survey of India, with the exception of a few specimens of loaches sent to the British Museum (Natural History). The types are deposited in the Indian Museum.

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[1] The commonest trout in these parts is *Salmo trutta aralensis oxianus* Kessler.

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Salmo trutta aralensis oxianus Kessler.

1842. *Salmo orientalis*, McClelland (*nec* Pallas), *Calcutta Journ. Nat. Hist.* ii, 585.
1843. *Salmo orientalis*, McClelland (*nec* Pallas), *Calcutta Journ. Nat. Hist.* iii, pp. 283-287.
1874. *Salmo oxianus*, Kessler, 'Pisces' in Fedtschenko's *Reise in Turkestan*, p. 35.
1932. *Salmo trutta aralensis* Berg morpha *fario* L., Berg. *Poiss. Eaux Douces de l' U.R.S.S. et des Pays Limitrophes* 3rd. Edition, i, p. 161 (See earlier references).
1933. *The Bamean Trout*, Hora, *Journ. Bombay Nat. Hist. Soc.* xxxvi, pp. 700-705, pl.-figs. 3 & 4, 2 text-figs.

In the recent collection of fish from Afghanistan, there are 3 specimens of the Bamean Trout, the largest is about 150 mm. in total length. Two of these were caught in the Darra Ashraf and one in the Margh stream. These two streams are 4 miles apart and run into the Surkhab river (Bamean river) which is a tributary of the Oxus.

Through the kindness of Prof. L. Berg, the Zoological Survey of India now possesses one of the typical specimens of *Salmo oxianus* Kessler (No. 2840 of the Zoological Museum at Leningrad). It is 208 mm. in total length and is in a very good state of preservation. It was obtained from 'Kyzyl-su river, Basin of the Upper Amu-darya, Alai Valley, Pamir'. A comparison between this and the Afghanistan specimen has shown that they are absolutely identical with the exception of such characters which are liable to vary with the length of the individuals.

The specimens from Afghanistan are in the Parr state and possess the characteristic colouration.

The vernacular name of the trout is *Māhī-i-Khāldār* which literally means 'a fish with spots'. I am informed that in standard Persian it is called *māhī-i-qizil-ālā* 'the red-speckled fish' and in the Turkish-speaking provinces of Persia *āla-bāliq* 'the spotted fish'. The Afghan name (not Kabuli but Persian) is, in view of the characteristic colouration, very appropriate.

Glyptosternum reticulatum McClelland.

1933. *Glyptosternum reticulatum*, Hora, *Journ. Bombay Nat. Hist. Soc.* xxxvi, p. 697 (see for earlier references).

A fine specimen of *Glyptosternum reticulatum*, 196 mm. in total length, was collected by Capt. E. W. Fletcher from the Banu Andrab river, about 79 miles north of Kabul at an altitude of 4,300 ft. The entire dorsal and lateral surfaces of the fish are reticulated with blackish spots and markings, and it is likely that such a colour-pattern may have been responsible for the specific name *reticulatum*. The caudal fin and the distal half of the anal fin are more deeply pigmented. The ventral surface in front of the ventral fins is roughened by small and hard papillae. The adipose dorsal is well developed, it is as long as the tail portion of the body without the caudal fin and its height is equal to half the width of the mouth.

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In the group of the Sisorid fishes to which *Glyptosternum* belongs, a new genus—*Oreoglanis*—has been described recently by Smith.[1] To indicate the relationship of this genus, he has given a key to the genera of Glyptosternoid cat-fishes. Moreover, he has indicated that, as already pointed out by me,[2] *Parexostoma* Regan is synonymous with *Glyptosternum* McClelland.

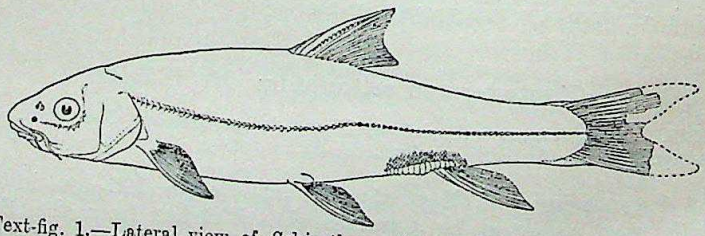
G. reticulatum has recently been found at two different places within the limits of Afghanistan.

Schizothorax intermedius McClelland.

1842. *Schizothorax intermedius*, McClelland, *Calcutta Journ. Nat. Hist.* ii, p. 579.

1868. *Schizothorax intermedius*, Günther, *Cat. Fish. Brit. Mus.* vii, p. 165.

In grouping species of *Schizothorax*, McClelland included *Sch. intermedius* and *Sch. esocinus* among those forms in which the lower lip presents 'a free reflected margin only at the angles of the mouth'. Besides this character, there is no other indication in the description of the former species by which it could be distinguished from the allied forms. Unfortunately McClelland did not publish any drawing of the species, so its determination would have always remained a guess-work had McClelland not sent 3 specimens of the species to the 'Museum at the India House', whence two examples (stuffed, 11 in. long and skin, 9 in. long) passed to the collection at the British Museum and served for the description of the species by Günther in his *Catalogue of Fishes*. I have no doubt that Günther had before him the typical specimens of the species. In the collection of fish from Afghanistan, there are two specimens—badly preserved and somewhat damaged —which agree very closely with Günther's description of *Sch. intermedius*. These were collected in the Logar river, a tributary of the Kabul river, to the south of Kabul. It is significant that the original specimens of the species were collected by Griffith in the Kabul river at Jallalabad and in the Tarnuck river.



Text-fig. 1.—Lateral view of *Schizothorax intermedius* McClelland. × ½.

From Günther's description of *Sch. intermedius* and from an examination of specimens before me, the following salient characters of the species may be mentioned:—

(i) Lower labial fold interrupted in the middle.

[1] Smith, *Journ. Siam Soc., Nat. Hist. Suppl.* ix, pp. 70-74, pl. iii, 1 text-fig. (1933).

[2] Hora, *Ann. Mag. Nat. Hist.* (10) x, pp. 176-179 (1932); *Cur. Sci.* i, p. 130 (1932).

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(ii) Commencement of dorsal fin nearly midway between the tip of the snout and the base of the caudal fin.
(iii) Eyes situated not entirely in the anterior half of the head.
(iv) Anal scales not much developed, the largest being scarcely half as broad as the orbit.
(v) Height of head at occiput considerably greater than its width.
(vi) Body without spots.

A perusal of the literature shows that a very wide interpretation has been given to *Sch. intermedius* and that several unrelated forms have been designated by this title. The confusion seems to have been started by Day,[1] who, in 1876 and 1878, described and figured specimens from Kashgar, Yangihissar and Sirikol as *Sch. intermedius*. I have examined some of these specimens in the collection of the Indian Museum, and find that in all of them the eye is situated entirely in the anterior half of the head, and that the anal scales are relatively larger. The dorsal spine is stronger and more coarsely serrated, and the scales are relatively much larger in size. Herzenstein[2] relegated *Sch. aksaiensis* Kessler and *Sch. affinis* Kessler to the rank of the subspecies of *Sch. intermedius* and described *malacorrhynchus* as a new subspecies. Berg[3] in his latest work has given a comprehensive scheme of classification of the various subspecies of *Sch. intermedius*. I am unable to agree to the system proposed by Berg, and in the absence of sufficient material of the Central Asiatic forms associated with McClelland's species, I am unable to define the specific limits of these forms. In order to facilitate reference, I give below a table of measurements of the two specimens, but it has to be understood that, due to the damaged condition and poor preservation of the specimens, some of the measurements are likely to be faulty.

Measurements in millimetres

Total length without caudal	96·0	156·0
Length of head	25·0	38·0
Height of head	15·2	25·8
Width of head	13·3	22·2
Length of snout	9·0	13·8
Diameter of eye	6·8	6·7
Interorbital width	7·8	13·5
Depth of body	18·5	30·0
Longest ray of dorsal	19·0	28·0
Longest ray of anal	16·5	26·8
Length of pectoral	19·8	28·0
Length of ventral	17·3	25·4
Length of caudal peduncle	17·3	27·0
Least height of caudal peduncle	8·5	14·5

[1] Day, *Proc. Zool. Soc. London*, p. 786 (1876); Ichthyology, *Sci. Res. 2nd Yarkand Miss.*, p. 5 (1878).
[2] Herzenstein, 'Fische', in *Wiss Res. Przewalski Central As. Reis. Zool. Theil*, iii (2), pp. 106-117 (1889).
[3] Berg, *Poissons des Eaux Douces de l' U.R.S.S.*, i, pp. 458-462 (1932). See earlier references.

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Local name:—The two specimens of *Sch. intermedius* were sent with the two specimens of the following species under the common name *Sheer-Māhi*.

Schizothorax chrysochlora McClelland.

(Pl.-fig. 4; text-fig. 2.)

1842. *Racoma chrysochlora*, McClelland, *Calcutta Journ. Nat. Hist. Soc.* ii, p. 577, pl. xv, fig. 2.

Schizothoraæ chrysochlora was described by McClelland from Mr. Griffith's notes and the figure is stated to have been 'reduced from his very excellent drawing'. The diagnosis of the species is very poor and of a generalized nature. It reads as 'Mouth directed forward, intermaxillaries protractile, without spots, scales small, raised on the lateral line, vertical anal scales large, colour brownish yellow, operculum square behind, intestine convoluted in a conical form in the anterior part of the abdomen, and equal to six lengths of the body'. *Sch. chrysochlora* is stated to grow to a length of 10 inches and was collected in the Kabul river at Lalpore. At Lalpore, Mr. Griffith 'procured a fish I believe identical with the nepoora of Assam, *C. falcatus* of Hardwicke, a Barbus, a Gonorhynchus, a small Mahasir, and a remarkable fish, which appears to me the type of *types* of Carnivorous *Poeonominae*'. It would thus appear that *Sch. chrysochlora* was obtained from the lower region of the Kabul river where there is a mixture of the Indian and Central Asiatic species of fishes. Under the description of *Racoma labiatus*, McClelland says: 'Mr. Griffith remarks that this singular form is nearly allied to the Lalpore species, but that the intestines of the latter are infinitely longer, nor is there any enlargement of the lips in the latter; but this last character Mr. Griffith remarks is not so remarkable in young specimens'. It is this indication of a close similarity between *labiatus* and *chrysochlora* that has helped me in assigning two badly preserved and damaged specimens from the Logar river, a tributary of the Kabul river, to *Sch. chrysochlora*. *Sch. labiatus* is the commonest species in the Chitral Valley, whence my colleague, Dr. B. N. Chopra, obtained a large series of nicely preserved specimens. This material has proved very useful in studying the form referred to as *Sch. chrysochlora* by McClelland.

In 1876, Day[1] described and two years later figured certain specimens collected by the Second Yarkand Mission at 'Kashghar, Yangihissar, and Yarkand' as *Sch. chrysochlorus*. In the collection of the Zoological Survey of India, there are several specimens purchased from Day and labelled as *Sch. chrysochlorus*. In these specimens the eye is entirely in the anterior half of the head, which is low and elongate. The snout is also very long and the fold of the lower lip does not extend beyond the symphysis. The anal scales are but little developed. In McClelland's *Sch. chrysochlora* the vertical anal scales are large and the fold of the lower lip is

[1] Day, *Proc. Zool. Soc. London*, p. 784 (1876); *Sci. Res. 2nd Yarkand Miss.*, Ichthyology, p. 3, pl. i, fig. 2 (1878).

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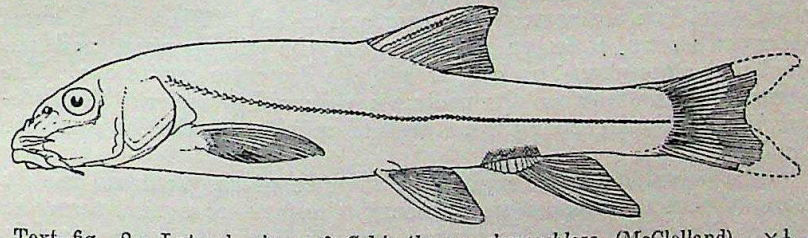
free throughout and somewhat trilobate as in *Sch. labiatus*. It would thus appear that Day's identification of the Yarkand Mission specimens as *Sch. chrysochlora* was not correct and that they in reality belong to *Sch. biddulphi* Günther.[1]

It would thus appear that since its discovery, *Sch. chrysochlora* has remained unknown and that both the description and figure of it by McClelland have not proved sufficient for elucidating its precise specific limits. Günther[2] included it among other ill-defined species of *Schizothorax*, and in 1889[3] doubted the use of the name by Day for a species from Yarkand. This point was elaborated by Herzenstein[4] who showed that Day was not justified in applying McClelland's name *Sch. chrysochlora* to a species so different from McClelland's original form.

From McClelland's original description and figure of *Sch. chrysochlora*, the following salient features may be noted, though the description is certainly very meagre and applicable 'to more than one species of *Schizothorax*' as remarked by Günther.

(i) Body without spots.
(ii) 'Scales small, raised on the lateral line, *vertical anal scales large*' (italics are mine).
(iii) The head is short and high.
(iv) The eye is situated almost in the middle of the length of the head.
(v) The species is found in the lower reaches of the Kabul river where certain species of the Indian fauna are also found.

The two specimens before me agree in all these points with McClelland's description, but unfortunately they are not in a good state of preservation and, therefore, a detailed description cannot be given. Attention may, however, be directed to some of the salient features to facilitate reference in future.



Text.-fig. 2.—Lateral view of *Schizothorax chrysochlora* (McClelland). ×½.

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[1] Günther, *Ann. Mag. Nat. Hist.* (4), xvii, p. 400 (1876).
Schizothorax biddulphi was described by Günther from two skins, the larger being 15.5 in. long. In Day's specimens and description of *Sch. chrysochlorus* the length of the head is about 4¾ to 5⅓ in the total length, but Günther says 'one-fifth of the total (without caudal)'. Günther usually excluded the caudal fin in giving the total length, but in this case I believe he meant to say 'with caudal'. In all other respects Day's *Sch. chrysochlorus* and Günther's *Sch. biddulphi* appear to be almost identical.
[2] Günther, *Cat. Fish. Brit. Mus.*, vii, p. 162 (1868).
[3] Günther, *Trans. Linn. Soc. London* (2), v, p. 107 (1889).
[4] Herzenstein, 'Fische', in *Wiss. Res. Przewalski Central Asi. Reis. Zool. Theil*, iii (2), pp. 154-156 (1889).

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D. 3/8; A. 3/5; P. 20; V. 10.

The dorsal profile rises abruptly from the tip of the snout to the nape and then gently to the base of the dorsal fin beyond which it slopes down to the base of the caudal fin. The ventral profile in front of the anal fin is almost straight or only slightly arched. The ventral surface of the head and the anterior part of the body is somewhat flattened. In the larger specimen, the maxillaries are protruded and the length of the head cannot be ascertained accurately. The length of the head is contained from 3·5 to 3·7 times in the total length without the caudal. The width of the head is contained 1·7 to 1·8 times and the height of the head 1·6 to 1·7 times in its length. The eye is dorso-lateral in position and is barely visible from the ventral surface; in the smaller specimen it is situated considerably nearer to the tip of the snout than to the posterior margin of the operculum, but in the larger specimen the eye is almost in the middle of the length of the head. The diameter of the eye is contained 4·7 to 5·0 times in the length of the head, 1·5 to 2·3 times in the length of the snout and 1·2 to 1·6 times in the interorbital width. These proportions indicate that the eyes undergo considerable variation both in size and position with the growth of the fish. The interorbital space is broad and flattened. The mouth is subterminal, transverse and arched; it is bordered by thick lips which are continuous all round the mouth so that the reflected posterior margin of the lower lip is entire. In the larger specimen, this labial fold is trilobed. The edge of the lower jaw is sharp and strong, and is covered with a horny covering. The barbels are subequal and longer than the diameter of the eye. The depth of the body is contained 5·2 times in the total length without the caudal. The scales are small, but those on the lateral line are somewhat larger and raised. There are several transverse rows of larger scales behind the gill-opening, and the anal scales are almost as long as half the diameter of the eye. The ventral surface between the pectorals is devoid of scales. The lateral line is complete and runs to the middle of the base of the caudal fin.

The dorsal fin arises slightly in advance of the ventrals and its commencement is considerably nearer the base of caudal than the tip of the snout. The last dorsal spine is bony, but quite flexible in the distal one-third of its length, and is serrated along the posterior border. The longest ray of the dorsal fin is shorter than the depth of the body. The pectoral, ventral and anal fins are long and pointed, but none of these fins, when laid flat, reaches the one following it. The caudal fin is damaged in both the specimens, but McClelland's figure shows it to be a deeply bifurcate structure. The anal opening is situated just before the anal fin. There is an adnate scaly appendage in the axil of the ventral fin. The caudal peduncle is about 1·7 to 1·9 times as long as its least height.

The colour is greyish above the lateral line, pale-olivaceous below it and much lighter on the ventral surface.

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Remarks.—As remarked by Griffith, *Sch. chrysochlora* has much in common with *Sch. labiatus* McClelland, and especially with those specimens of the latter in which the labial fold is not well-developed. I have dealt with the variation exhibited by *Sch. labiatus* in my report on the Chitral Fishes published in the *Records of the Indian Museum*. I have compared the larger specimen of *Sch. chrysochlora* with a specimen of the same size of *Sch. labiatus* with the following results:—

In *Sch. labiatus* the body is more slender and the head is considerably pointed; the labial fold is well-developed and prominently trilobed, the commencement of the dorsal fin is almost midway between the tip of the snout and the base of the caudal fin, and the anal scales are very small, considerably less than half the diameter of the eye. It is thus seen that the two species can be readily distinguished from each other.

Measurements in millimetres.[1]

Total length without caudal	94·5	177·0
Length of head	26·3	47·0
Height of head	15·0	29·6
Width of head	14·2	26·5
Length of snout	9·5	21·0
Diameter of eye	5·6	9·3
Interorbital distance	6·7	15·3
Depth of body	18·0	31·0
Longest ray of dorsal	17·4	32·0
Longest ray of anal	15·7	31·0
Length of pectoral...	18·2	34·3
Length of ventral	15·0	32·0
Length of caudal peduncle	16·0	30·8
Least height of caudal peduncle	9·0	16·0

Local name.—*Sch. chrysochlora* is locally known as *Sheer Māhī*, which literally means milk-fish or sweet-fish. It seems to be a common name for species of *Schizothorax* in Afghanistan, and in this reference is made probably to the taste of the flesh of these fishes.

[1] On account of the protruded condition of the upper jaw and poor condition of preservation of the specimens, the measurements are likely to be faulty in certain cases, and should, therefore, be taken with considerable reserve.

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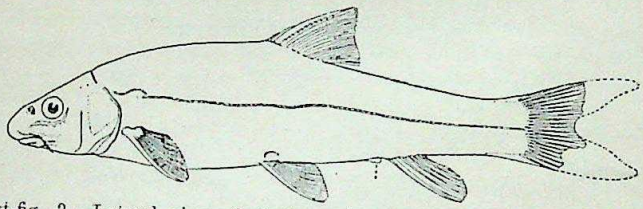
Oreinus sinuatus var. **griffithii** McClelland

(Plate-fig. 3; text-fig. 3.)

1933. *Oreinus sinuatus* var. *griffithii*, Hora, *Journ. Bombay Nat. Hist. Soc.* xxxvi, p. 700.

In the collections of fish made in Afghanistan during 1933, there is a single specimen of the genus *Oreinus*, which I refer to *O. sinuatus* var. *griffithii*. The specimen was collected by Major A. E. Farwell at Sar-i-Chashma, the source of the Kabul river; it is 136·5 mm. in length without the caudal and is in a fine state of preservation. In my article[1] on the fish of Afghanistan, reasons were given for regarding the Kabul river form as distinct from *O. sinuatus*, though both are very much alike superficially. I have described this form in detail in my account of the fish of Chitral which will be published in the *Records of the Indian Museum*.



Text-fig. 3.—Lateral view of *Oreinus sinuatus* var. *griffithii* McClelland.

The following note from Griffith's observations is of special significance. Writing of the fish fauna of the Kabul river, he says: 'Towards its origin, and throughout the upper part of the Mydan Valley, a species of Oreinus is very abundant, numbers may be taken with a worm, the only instance I know of a fish with a Gonorhynchoid mouth taking bait. This same species swarms in the fine springs (from limestone) at Sar-i-Chashmah, which are the main source of the river; the fish are considered sacred, and appear to eat anything presented to them; the size does not exceed 5 lbs.'[2]

Alburnoides bipunctatus var. **eichwaldi** (Filippi).

1932. *Alburnoides bipunctatus eichwaldi*, Berg, *Poiss. des Eaux Douces U.R.S.S.*, i, p. 493 (see synonyms).

There is a single specimen, 74 mm. in length without the caudal, which I assign to *Alburnoides bipunctatus* var. *eichwaldi*. It was collected from the Margh river, a tributary of the Surkhab river. It has alrealy been indicated[3] that this is one of the species commonly found in the Upper Amudaria.

The fish is locally known as *Māhī putrā*.

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[1] Hora, *Journ. Bombay Nat. Hist. Soc.*, xxxvi, p. 700 (1933).
[2] Griffith, *Calcutta Journ. Nat. Hist. Soc.*, ii, p. 564 (1842).
[3] Hora, *Journ. Bombay Nat. Hist. Soc.*, xxxvi, p. 706 (1933).

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Barbus capito conocephalus Kessler × **Schizothorax** sp.

(Plate-figs. 5 & 6.)

In the small collection made by Capt. E. W. Fletcher in July 1933 from the Banu Anderab river, there is a small fish, 95 mm. in total length, which appears to be a hybrid between *Barbus capito conocephalus* and some species of *Schizothorax*. In general facies, it resembles the fishes of the subfamily *Schizothoracinae*, but possesses relatively larger scales. The lower jaw is bare anteriorly and the lip is somewhat papillated, so that the ventral surface of the head gives the appearance of a young *Oreinus*. A somewhat similar hybrid—*Barbus capito conocephalus* × *Schizothorax pseudaksaiensis issykkuli*—has been figured by Berg,[1] but, as compared with it, the head in the specimen under report is relatively short, high and much more rounded anteriorly. From the build of its head, it seems likely that the Afghanistan specimen is the result of crossing of the species of *Barbus* referred to above and *Schizothorax irregularis* (Berg, *Sch. intermedius irregularis*, *l.c.*, p. 460, fig. 385), but in the absence of sufficient material, it is not possible to be dogmatic about this suggestion. The interesting specimen is, however, described and figured here for future reference.

D. 3/8; A. 2/5; P. 15; V. 9; C. 20, besides smaller rays at the sides.

The specimen is subcylindrical with a short and rounded head. The ventral surface of the head is somewhat flattish and both the profiles are only slightly arched. The length of the head, of the caudal fin and the depth of the body are equal and are contained 5 times in the total length and 4 times in the length without the caudal. The width of the head is contained 1·6 times and the height of the head at the occiput 1·4 times in the length of the head. The eyes are large, dorso-lateral in position and hardly visible from the ventral surface; they are mostly situated in the anterior half of the head. The diameter of the eye is contained 3·8 times in the length of the head and 1·2 times in the length of the snout and the interorbital width. The nostrils are situated near the anterio-superior border of the eye. The mouth is transverse, semicircular and inferior; it is bordered by flat lips which are continuous at the angles of the mouth; the labial fold is interrupted in the middle; the flat, lower lip is finely papillated. The distal portion of the upper jaw is vertical and, when the mouth is closed, it lies in front of the lower jaw, which is hard, sharp and shovel-shaped for rasping purposes. A portion of the lower jaw is not covered by the lip anteriorly. There are two pairs of well-developed barbels, both longer than the diameter of the eye.

The base of the dorsal fin is midway between the anterior border of the eye and the base of the caudal fin; its longest ray is not as high as the depth of the body below it. The last spine is bony, but weak, and strongly denticulated posteriorly; there are about a dozen pair of teeth along the posterior border. The dorsal fin

[1] Berg, *Poisson des Eaux Douces U.R.S.S.*, 3rd ed., i, p. 450 (Leningrad: 1932).

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commences considerably in advance of the ventrals. The pectoral fins are long and pointed, but do not extend as far as the base of the ventrals, which are similar to the pectorals and do not reach the anal-opening. The anal fin, when adpressed, does not reach the base of the caudal fin. The caudal fin is deeply forked and the lobes are sharp and pointed; the upper lobe is slightly longer than the lower. The caudal peduncle is 1·4 times as long as its least height.

The lateral line is complete and runs to the middle of the base of the caudal fin. The scales are small and imbricate. There are about 82 rows of scales in a longitudinal series, 14 between the lateral line and the commencement of the dorsal and 11 rows between the lateral line and the base of the ventral. There is a fleshy appendage in the axil of the pectoral fin, but none above the base of the ventral fin. The anal-opening and the anterior part of the base of the anal fin are provided with rows of somewhat larger scales. On the ventral surface the scales are embedded in the skin and there are only faint indications externally.

The colour is grayish above and pale-olivaceous below. The sides are marked with small, irregular patches of black colour which usually characterize the young *Schizothoracinae*.

Measurements in millimetres.

Total length including caudal	95·0
Length of caudal	19·0
Depth of body	19·0
Length of head	19·0
Width of head	11·8
Height of head at occiput	13·5
Length of snout	6·0
Diameter of eye	5·0
Interorbital width	6·0
Longest ray of dorsal	16·0
Longest ray of anal	13·0
Length of pectoral	16·0
Length of ventral	13·3
Length of caudal peduncle	14·0
Least height of caudal peduncle	9·8

GENUS: **Nemachilus** van Hasselt.

(Plate-figs. 1 & 2; text-fig. 4.)

The species of the genus *Nemachilus* are so numerous and the characters by which they are usually differentiated are so variable

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that considerable difficulty has often been experienced in separating one form from the other. This is specially so in the case of related species. The Nemachili from Afghanistan have hitherto proved to be a very confusing lot, but an attempt is made here to elucidate the precise limits of the various forms.

In 1929[1] attention was directed to the type material of two loaches from Afghanistan in the collection of the British Museum which had been erroneously stated to have come from 'Bhoutan' and 'Assam' in Günther's *Catalogue*.[2] Short notes were published then on the type specimens of *Adiposia boutanensis* (McClell.) and *Nemachilus griffithii* Günther, and their probable affinities were discussed. It was further stated that the former species was probably obtained in the Helmand basin near the Bolan Pass and the latter from the Arghandab river near Candahar. In 1933,[3] I assigned two specimens collected in the Paghman river, a tributary of the Kabul river near Kabul, to *N. griffithii* and published a detailed account with figures. It was indicated that the Paghman specimens differed from the typical examples in several important respects, but on account of the paucity of the material and the much smaller size of the fresh specimens, it was not considered advisable to propose a new name for them. In the collection under report, there are 23 specimens of the genus *Nemachilus*, 18 from the Helmand river basin and 5 from the Kabul river basin. Of the Kabul river specimens, 4 were obtained in the spring at Sar-i-Chashma and 1 in the Chahiltran stream; and these (text-fig. 4*c*) correspond in every respect with the specimens already reported from the Paghman river. It may be recalled that Griffith[4] observed a loach very common in the small channels by which the springs at Sar-i-Chashma run off. It is thus clear that in the Kabul river and its tributary streams, at least in the neighbourhood of Kabul, this particular type of loach is common, and as it differs in certain particulars from *N. griffithii*, I propose to treat it here as a separate variety which may be designated as **afghana.**

Through the kindness of Dr. C. Tate Regan and Mr. J. R. Norman, I have received on loan one of the two typical specimens of *N. griffithii* from the British Museum (Natural History). In forwarding the specimens Mr. Norman has observed that it 'differs somewhat from the other type in having a generally shorter and thicker body, shorter and less slender caudal peduncle and a rather larger head. We have little doubt, however, that in spite of these differences, the two types represent the same species'. The specimen (text-fig. 4*a*), which I have studied, is not in a good state of preservation, and is too flabby for accurate measurements. So far as it can be ascertained the length of the head is contained 4·7 times in the total length without the caudal, and the commencement of the dorsal

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[1] Hora, *Journ. Proc. As. Soc. Bengal* (n.s.), xxiv, pp. 481-484, 1928 (1929).
[2] Günther, *Cat. Fish. Brit. Mus.*, vii, pp. 358, 360 (1868).
[3] Hora, *Journ. Bombay Nat. Hist. Soc.*, xxxvi, pp. 697-699, pl.-figs. 1 & 2 (1933).
[4] Griffith, *Calcutta Journ. Nat. Hist.*, ii, p. 564 (1842).

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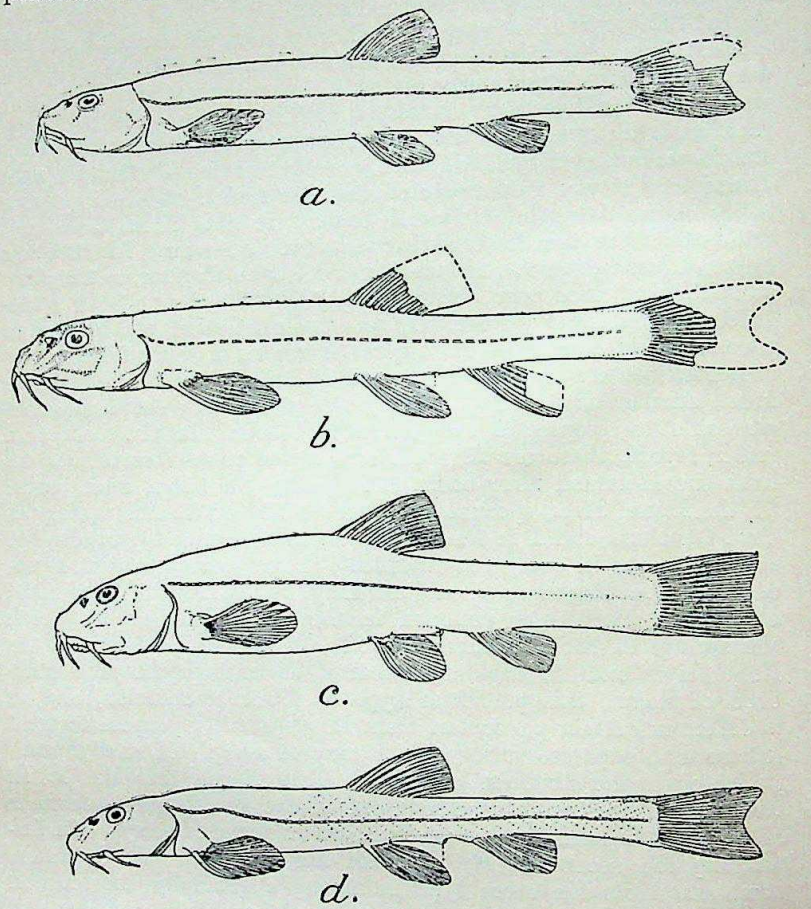
fin is nearer to the base of the caudal than to the tip of the snout. The distance between the pectoral and the ventral fins is about equal to the length of the pectoral. The least height of the caudal peduncle is contained 2·5 times in its length. The caudal peduncle



Text-fig. 1.—*Nemachilus* from Afghanistan.
Lateral view of (*a*) *Nemachilus griffithii* Günther, type-specimen ×$\frac{3}{4}$; (*b*) *Nemachilus griffithii* Günther, young specimen ×1$\frac{1}{3}$; (*c*) *Nemachilus griffithii* var. *afghana*, nov., type-specimen ×1; (*d*) *Nemachilus farwelli*, sp. nov., type-specimen ×$\frac{3}{4}$.

is muscular but is not much compressed from side to side. The diameter of the eye is contained 7·5 times in the length of the head, 3 times in the length of the snout and 1·5 times in the interorbital width. The snout is shorter than the postorbital part of the head. On comparing the above notes with the description of the species by Günther, two conclusions seem to be justified, (1) that Günther probably used the longer and narrower specimen for drawing up his description and (2) the species is subject to considerable vari-

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ation in proportions, etc. It is for these reasons that I have still linked the Kabul river specimens with *N. griffithii*.

There are in the collection 17 specimens collected by Major A. E. Farwell in the Sar-i-Bulak stream, a tributary of the Helmand river, which appear to belong to *N. griffithii*. The specimens are young (Plate-fig. 1, and text-fig. 4*b*) and in all cases the fins are greatly damaged. However, in these examples the fins are relatively longer, the eyes are larger, the head is longer, and there are other points in which they differ from the typical examples, but, probably, all these differences are due to their juvenile state. It may, however, be indicated that these examples are very different from specimens of the same size of the form *afghana* referred to above from the Kabul river.

A fine specimen (plate-fig. 2 & text-fig. 4*d*) collected by Major A. E. Farwell in the Helmand river is so different in the form and shape of its caudal peduncle, general facies and proportions that it seems to represent a form hitherto undescribed. It is associated with the name of Major Farwell in slight recognition of the interest taken by the officers of the British Legation at Kabul in making known the ichthyology of this interesting region.

Nemachilus griffithii var. **afghana**, nov.

1933. *Nemachilus griffithii*, Hora, *Journ. Bombay Nat. Hist. Soc.* xxxvi, pp. 697-699, pl. i, figs. 1 & 2.

Major A. E. Farwell obtained 4 young specimens ranging in length from 54 mm. to 97 mm. including the caudal fin from the springs at Sar-i-Chashma, the source of the Kabul river. Griffith[1] remarked that 'In the small channels by which the springs run off, a loach is very common'. These specimens agree very closely with the examples described by me (1933) from the Paghman river. It has to be noted, however, that the latter were not well preserved and the swollen nature of the opercular region was a mere artifact. Both the lips are fleshy and plicated; the lower lip is very narrowly interrupted in the middle. The colour varies with the size of the specimens. Along the lateral line there is either a series of rounded spots, a moniliform band or a grayish streak. The caudal fin is more or less truncate and not emarginate.

A young specimen of the species was also collected by Sir Richard Maconachie in the Chahiltran stream, a tributary of the Kabul river about 6 miles to the west of the Kabul City.

Type-specimen.—No. F $\frac{11525}{1}$, *Zoological Survey of India, Indian Museum, Calcutta.*

Nemachilus farwelli, sp. nov.

(Pl.-fig. 2; text-fig. 4*d*.)

D. 2/7; A. 2/5; P. 1/11; V. 1/8; C. 16 (besides smaller rays at the sides).

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[1] Griffith, *Calcutta Journ. Nat. Hist.*, ii, p. 564 (1842).

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The new species of *Nemachilus*, which I have great pleasure in associating with the name of Major A. E. Farwell, Military Attaché to the British Legation at Kabul, has a very characteristic form. It is somewhat broad and depressed in the anterior region, but behind the dorsal fin it is greatly compressed from side to side. The tail portion is long and oar-like. All along the dorsal surface behind the head, the neural spines of the vertebrae form a prominent ridge. The following measurements give an idea of the form of the fish:—

	mm.
Height of head in the region of eyes	9·0
Height of head at occiput	10·6
Greatest height of body above middle of pectorals ...	12·7
Height of body at the commencement of dorsal fin ...	10·3
Height of body at the commencement of anal fin ...	7·8
Least height of caudal peduncle	6·8
Width of head in the region of eyes	11·7
Width of head in the opercular region	14·7
Width behind bases of pectorals	11·7
Width at the commencement of ventrals	6·5
Width at the commencement of anal	4·3
Least width of caudal peduncle	1·6

The dorsal profile is slightly arched, but the ventral profile is straight and horizontal throughout. The ventral surface is flattish and the paired fins are horizontally placed.

The head is depressed on both the dorsal and ventral surfaces; its length is contained 6·1 times in the total length with the caudal and 5·1 times without the caudal. The width of the head is contained 1·5 times and its height 2·1 times in its length. The snout is almost equal to the height of the head at the occiput. The eye is dorso-lateral in position and is not visible from the ventral surface; its diameter is contained 5·3 times in the length of the head, 2·4 times in the length of the snout, and 1·3 times in the interorbital width. The interorbital arc is almost flat. The nostrils are well developed and are situated much nearer the eye than the tip of the snout. The dorsal surface of the head is marked with series of lateral line organs which will be described below. The mouth is inferior, transverse and crescentic; it is situated considerably behind the tip of the snout and is co-extensive with the width of the head. The lips are well developed, fleshy and continuous at the angles; the lower lip is narrowly interrupted in the middle line. Both the lips are greatly fimbriated; the lower lip leaves the

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jaw bare anteriorly. Both the jaws are strong and well developed; the anterior jaw lies in front and forms a hood-like covering over the posterior jaw which is provided with a sharp, rasping edge and is shovel-like. There are 6 barbels which are longer than the diameter of the eye; the maxillary barbels are the longest, but they are considerably shorter than half the length of the head. The gill-opening is lateral, extending for a short distance only on the ventral surface.

The body is smooth and devoid of scales; its greatest depth is contained 11 times in the total length with the caudal and 9·2 times without it. The lateral line is complete and forms a ridge-like prominence on the body. The lateral lines of the two sides are united dorsally by a transverse series of perforations along the posterior border of the head. Each lateral line is continued forwards to the middle of the eye where it is divided into two branches, the dorsal reaches the nostrils, while the ventral branch extends as far forwards as the angle of the mouth.

The dorsal fin commences slightly in advance of the ventrals, and its longest ray is considerably greater than the depth of the body below it. The commencement of the dorsal is nearer tip of snout than base of caudal; its free end is truncate. The pectorals are broad and horizontal in position; they are somewhat shorter than the head and are separated from the ventrals by a considerable distance. The ventrals are long and pointed, and extend beyond the anal opening, but do not reach the base of the anal fin; they are slightly shorter than the pectorals. The anal fin is similar to the dorsal. The caudal fin is almost as long as the head and is slightly emarginate. The caudal peduncle is oar-like; it is about 4 times as long as its least height.

The anal-opening is preceded by a tube in which there is a papilla-like structure. Between the anus and the anal fin there is a well-defined, narrow groove with raised margins. It is not possible to give the function of this structure which is very characteristic of the species.

The colouration in the spirit specimen is almost black along the dorsal surface and dirty white on the ventral surface. There are few indications of regular spots on the body below the lateral line. The dorsal and the caudal fins are marked with several indistinct bands and the other fins are also provided with a few irregular colour patches.

Locality.—Helmand river, Afghanistan.

Type-specimen.—No. F $\frac{11515}{1}$, *Zoological Survey of India, Indian Museum, Calcutta.*

Remarks.—In general facies *Nemachilus farwelli* is remarkable, and though I have handled big collections of Nemachili, I have not come across any form approaching it in the shape of its caudal peduncle. The position of the dorsal fin and the nature of its lips are other distinguishing characters. The well-marked groove between the anus and the anal fin is also characteristic of the species. *Nemachilus farwelli* has no resemblance to the species of

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Adiposia[1] *A. macmahoni* (Chaudhuri), *A. rhadinaea* (Regan) and *A. boutanensis* (McClelland)—known from the lower reaches of the Helmand system. *N. tenuis* Day, which has been recorded from the Helmand river,[2] possesses a rounded, slender and long caudal peduncle.

Measurements in millimetres.

Total length including caudal	140·0
Length of caudal	22·0
Depth of body	12·7
Length of head	22·8
Length of snout	10·5
Interorbital width	5·5
Diameter of eye	4·3
Width of head	14·7
Height of head at occiput	10·6
Longest ray of dorsal	20·8
Length of pectoral	20·0
Length of ventral	19·0
Longest ray of anal	18·0
Length of caudal peduncle	27·2
Least height of caudal peduncle	6·8

[1] Annandale & Hora, *Rec. Ind. Mus.*, xviii, pp. 182-190, text-figs. 10, 12-15, pl. xv, fig. 4; pl. xvi, figs. 1 & 2 (1920); Hora, *Journ. As. Soc. Bengal* (n.s.), xxiv, pp. 481, 482, fig. 1 (1929).

[2] Hora, *Rec. Ind. Mus.*, xxiv, p. 77 (1922).

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TRANSFORMATIONAL DECEPTIVE RESEMBLANCE AS SEEN IN THE LIFE HISTORY OF A PLANT BUG (*RIPTORTUS PEDESTRIS*), AND OF A MANTIS (*EVANTISSA PULCHRA*).

BY

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(*Lecturer in Zoology, H. H. The Maharajah's College of Science, Trivandrum*).

(*With a plate*).

Riptortus pedestris.

While making a collection of ant mimics from Mavalikara, Central Travancore, in 1930, I came across certain bugs which were moving about on *Cassia occidentalis* and which presented a very perfect resemblance to the Red Ant, *Oecophylla*—even more perfect than the mimicry which I was observing and studying in the Attid spiders. On closer examination I found a number of other bugs, imitating other ants, also moving about in close proximity. Some were smaller and lighter coloured—the very images of *Plagiolepis* ants; others were quite dark and larger, resembling perfectly certain species of Black Ant, *Camponotus*. Whether these ant mimics were separate species or merely successive stages of the same species or of different species could not be ascertained. So a number of them were collected and reared in cages at home. Their development showed that these bugs were only successive stages in the life history of a common *Coreid* bug (*Riptortus pedestris*) which, by the way, when fully grown, has no resemblance to an ant. Desiring to work out this interesting life history I secured a few males and females and reared them in cages at home. They paired and laid eggs. These hatched and the stages were followed.

The Eggs.—These when freshly laid are of a greenish colour but soon become dark brown. They are more or less oval structures attached singly to the leaves of *Cassia occidentalis* or to any other convenient object. The upper surface of the egg is flattened and broad, while towards the base, by which it is attached to the leaf, it becomes narrower. A female seems to lay only 8 to 10 eggs at a time.

The eggs hatch in 6, 7 or sometimes 8 days. The upper broad part is slit and lifted away like a lid and the young one crawls out of the egg case. Even as it crawls out it appears to undergo the first moult—the shrivelled up cast off skin is left peeping out of the egg case (Figs. 1-A & B).

The First Stage.—The young bug, immediately after it has come out of the egg case is of a beautiful red colour which gradually turns brown from the abdomen forwards and in a short time becomes quite dark brown. It is a perfectly ant like little insect there being no trace of the dorso-ventral flattening of the body, so characteristic of the *Hemiptera*. The large head followed by an elongated and cylindrical thorax, at the end of which is the swollen oval abdomen, gives this insect its striking ant-likeness.

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The resemblance is increased by the antennae, usually extended forwards and waved to and fro as the insect moves about. In colour, general movements, size and appearance, it is almost indistinguishable from the small dark brown ants—*Prenolepis longicornis*—so common here (Figs. 2 & 3).

The *Coreidae* as a family are characterised by a disproportionate enlargement of the third pair of legs; but in these newly hatched young there is no such enlargement.

The head is oblong, longer than the pronotum and produced in front of the eyes. Behind the eyes it is convex. There are a number of short stiff white hairs on the head, directed forwards. Antenna four jointed, slightly longer than the body, the fourth joint being the longest. The eyes are prominent, placed slightly behind the middle of the head; ocelli absent. The rostrum reaches a little beyond the second coxa. It is four jointed, the first joint being stout and less than half the length of the head. The second and third joints are each more or less equal in length to the first, but the last joint is a little longer.

Just behind the head, at the neck region there is a narrow white band forming a 'collar'. The thorax is much elongated and almost cylindrical, quite unlike the usual hemipteran thorax. The characteristic pronotal angles are not developed. The pronotum is short, convex dorsally and on the sides, and truncate behind.

Behind the thorax, in the anterior part of the abdomen, is a broad white band ventrally, extending upwards in triangular patches on either side, which effectively produce the appearance of the narrow 'waist' of the ant. The abdomen is globose with dorsal stink glands.

A specimen prior to the next moult measured 3·3 mm. When just hatched it measured only 2·2 mm.

The Second Stage.—In two days' time the young bugs moult. The similarity to the ant becomes intensified. The bug, now larger and more elongated, is of a bright yellowish-brown colour. Its antennae are long and held forwards. In coloration, general appearance and movements, it now bears a very striking resemblance to a *Plagiolepis* ant. At Mavalikara, where I have seen large numbers of these bugs breeding under natural conditions, I have mostly come across the young bugs at this stage on their food-plant, in company with many *Plagiolepis* ants which roam over it. Distinction between the young bugs and the *Plagiolepis* ants is by no means easy. The bug's mimicry at this stage is almost perfect (Figs. 4 & 5).

When the *Plagiolepis* ants are disturbed they run about wildly and many of them fall to the ground. The young bugs behave in a similar manner. When disturbed they quicken their pace, run about wildly and often fall down into the debris below. This must be protective; once among the debris, with many of the ants moving about detection of the bugs is almost impossible.

The general build of the body is the same as in the previous stage. The head in front of the eyes is pubescent with white hairs directed forwards. Behind the eyes there are a few stouter and shorter black hairs directed upwards in the middle, and outwards

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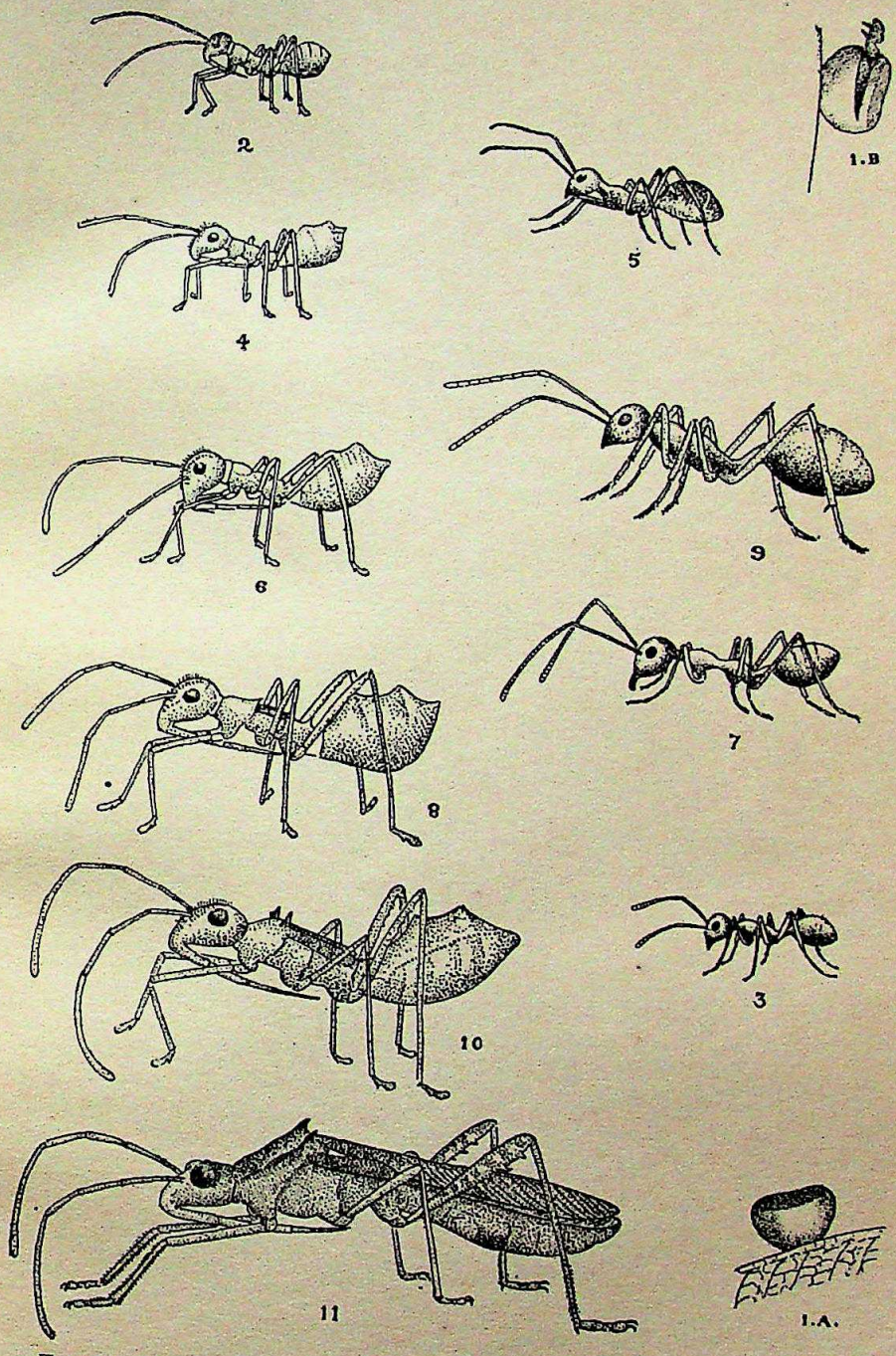

Trans-deceptive resemblances as seen in the life-history of a Bug (*Riptortus pedestris*).

(*For explanation of plate see end of article.*)

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on the sides. On the thorax are a few black hairs mixed with white. The abdomen bears shorter and softer white hairs. The rostrum has the third joint shortest and the fourth the longest. The hinder border of the mesonotum develops a median extension backwards—the beginning of the scutellum. The first two segments of the abdomen are narrow. The first segment has a small process projecting upwards. The second segment has two broad triangular white patches, one on either side, which mask a good region of the sides, and produce the appearance of a narrow 'waist'—so characteristic of the Hymenoptera, but not found in the Hemiptera. Immediately beyond this, the abdomen is swollen and globose. On the dorsal surface are two tubercles on which the stink-glands open.

In this stage, while the majority retained their reddish-yellow coloration, a few showed a tendency to turn darker. Some turned dark-red while others became quite dark. The latter individuals thus lost all similarity to *Plagiolepis* ants; but their appearance and colour made them almost indistinguishable from the smaller individuals of a species of *Camponotus* ants which are also common in the locality.

A specimen in this stage measured 4·4 mm.

The Third Stage.—The next moult takes place within 4 to 6 days. During this moult variations in colour are even more pronounced than in the previous stage. Some of the reddish-yellow forms on moulting retain the reddish yellow coloration; others turn several shades darker while a third lot turn quite dark. The dark-red forms and the dark forms on moulting to this stage produce the dark types. Thus in this third stage there are three forms of bugs—reddish yellow, dark reddish, and black. An attempt was made to ascertain if this change of coloration had any relation to the colours of the surroundings. Individuals were reared in different backgrounds but the results were negative. Whatever the nature of the background the bugs on moulting seemed to produce all three colour forms. Nor does variation in colour depend on the food; for they are all fed on the same diet.

The reddish-yellow forms bear the closest possible similarity to the red ant, *Oecophylla smaragdina*, in size, coloration, and general build of the body. The ant's abdomen has a conspicuous black mark on its under side and it is quite striking to note a similar dark patch on the ventral side of the swollen part of the abdomen of the bug. In both, ant and bug, this black patch is an internal structure seen through the translucent abdomen and not a superficial mark. The ant, when alarmed raises its abdomen—an act which makes this mark quite visible; the bug too, raises its abdomen as it moves about, though to a much less extent. Thus its behaviour is very similar to that of the ant. The antennae are ordinarily held either forwards or sideways with a distinct bend or 'elbow', a little above the base, thus simulating the elbowed antennae of *Oecophylla* (Figs. 6 & 7).

The ants and the bugs are frequently found on a species of *Cassia*. The bugs ordinarily remain stationary on the leaves or pods; the ants though by nature very active are often reduced to passivity when stroking the glands of or 'milking' aphides. When

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disturbed the bugs become active and move about quickly after the fashion of the ants. They often fall down from the plant to the debris below when disturbed—which *Oecophylla* seldom does though some other ants do it. This, as has been already explained, must be an additional protective device.

The general build of the body of the bug is similar to that in the previous stage; but a closer examination shows that traces of the adult characteristics have begun to form, though still not quite obvious at a casual glance. The pronotum is shorter than broad and, at the hinder margin, the pronotal angles are distinct. The hinder margin of the mesonotum is seen to be divided into three lobes projecting backwards—two lateral and one median. The lateral lobes represent the incipient tegmina while the median lobe is the hinder end of the scutellum.

The rostrum reaches to between the third coxa. The third joint is the shortest and the fourth the longest.

The first abdominal segment has a well developed spine projecting upwards. The hinder portion of the abdomen is globular. Dorsally on this globular portion are two tubercles on which the stink glands open.

A specimen in this stage measured 6 mm.

The Fourth Stage.—The next moult takes place in 2 to 4 days. All the black specimens when moulted retained the dark colouration. Some of the reddish ones on moulting retained their colour, others became dark like those produced from the dark ones. Some which retained the red coloration on moulting, gradually changed several shades darker as they grew. Perhaps this is only an instance of delayed pigment development. In all instances, when just moulted, the specimens are reddish; the dark ones attain their colour only after a short interval. In this stage therefore, there is a definite preponderance of black, the lighter-coloured individuals being few.

Red individuals still continue their resemblance to *Oecophylla* though, as they grow fast and the body gets more enlarged, the similarity decreases. The characteristics of the adult get more evident. It is from this stage then that the typical *Hemipteran* and *Coreid* characters become more clearly distinguishable in these bugs and the ant-likeness gradually lessens. The more pronounced development of the scutellum, tegmina and the wings, pronotal angles, etc., make the bugs more or less easily distinguishable to a careful observer, though at a casual glance, these may yet be overlooked. Black individuals still mimic the *Camponotus* ants, the larger individuals of the ants serving as models now. Still, as in the case of the red ones, the distinctions have already become evident and the mimicry is much less perfect than in the earlier stages. It is also to be noted that the bugs now become more sluggish in their movements compared to the earlier stages.

Compared with the previous stage the bugs show marked differences in the thorax. It loses the cylindrical nodular form which gave it such a striking similarity to the curious thorax of the *Oecophylla*. It is now slightly flattened above and the scutellum and the rudiments of the tegmina and the wings are all dis-

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tinct. The pronotal angles are well-developed. The white triangular patch on either side of the anterior region of the abdomen is still distinct. The last leg has become comparatively stouter than in the previous stages and the femur just shows the beginnings of the spines which are so characteristic of the adult (Figs. 8 & 9).

The total length of a specimen measured was 8 mm.

The Fifth Stage.—The specimens moulted to the penultimate stage in 4 days. They have now grown considerably larger and have a dirty dark-brown colour. The almost exact ant-likeness of the previous stages is lost, though a general resemblance may still be recognised (Fig. 10).

The dorsal surface of the pro-thorax slopes upwards and posteriorly inclining at an angle of 45°, thus producing a bend for this region which is characteristic of the adult but is absent in the previous stages, where the pronotum is quite horizontal. The hinder border of the pronotum projects backwards as a distinct ledge, bearing spines at the angles and also one spine in the middle at the base of the scutellum. Behind the first coxa and faintly behind the second also, are marks representing the stink glands of the adult. The glands are being formed; but they are not yet open.

The abdomen is still swollen but has lost the almost globular shape of the previous stages. Seen from above it is more or less lozenge-shaped in outline having the centre considerably raised. Here are the stink-glands which are to close up by the next moult. Posteriorly the abdomen tapers. The 'waist region' so deceptively formed by white patches in the previous stages has disappeared altogether.

Length of a specimen measured was 11 mm.

In this as also in the previous stage, the bug presents a very striking similarity to *Dulichius* and strangely enough on comparing the specimen with the description of *Dulichius inflatus* as given in the F.B.I. they were found to agree in most respects. A few specimens were sent to the Indian Museum and I was informed that these specimens should certainly be put in the genus *Dulichius* and quite probably are *D. inflatus*. From this species, however, it differs slightly in the proportionate length of the rostral joints. In the nymph though the second joint is the longest, it is longer than the third and fourth joint together. In *Dulichius*, however, the second is the longest being a little longer than the third and the fourth together. But for this, in all other details, the two appear to agree perfectly. Curiously enough, the single specimen of *Dulichius inflatus* in the Indian Museum, in this respect, agrees with these nymphs and differs from the description in the F.B.I. since in this specimen also the second joint is not longer than the third and the fourth together. Perhaps it is this or a similar stage of some closely-allied form that has been described as *D. inflatus*. What Dr. Bergroth remarks with reference to the specimens sent by Mr. Wroughton is quite interesting. He says 'Mr. Wroughton has only found the brachypterous form. If the species has a macropterous form it is probable

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that the form has little or no resemblance to an ant' (Ent. Month. Mag., 1892, 107).

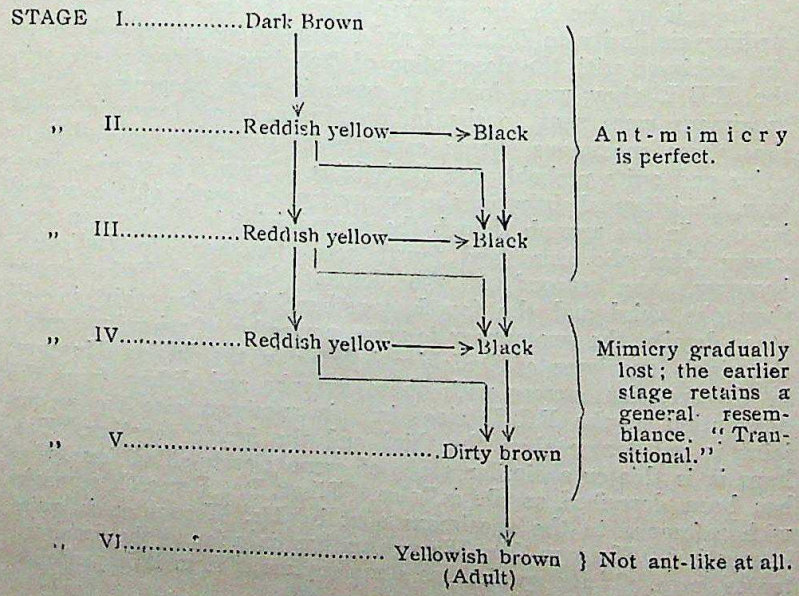
A number of bugs have been described without wings but which later on were found to have fully-winged forms—for example, *Eugubinus*. The case of *Dulichius inflatus* might be only similar; it is only the nymph of a *Coreid* bug with fully-developed wings in the adult stage during which there is absolutely no trace of ant-likeness.

The Sixth Stage.—The next moult, by which the bugs become adults takes place in 5 to 8 days. The moulting is similar to the previous ones. The cuticle splits at the median line on the thorax and the thorax is first pushed out, the head being bent double. Then gradually the insect pushes itself forwards, drawing out the limbs, antennae and rostrum. The hinder part of its abdomen still remains in the old skin. The wings are pale and do not reach up to the tip of the abdomen. The legs and antennae are raised and slowly moved about. The bug is now of a beautiful coral red colour with lighter bands on the legs and antennae. As the cuticle hardens this colour changes to a dirty-brown.

The adult has no likeness to the ant and is of a dull brown colour. The wings are developed; ocelli are present; abdomen typical; tarsus three-jointed. As the bugs sit quietly on the dry pods of *Cassia occidentalis* or on its withered leaves—a position where they are quite often encountered—they are quite unrecognisable. They have the habit of collecting together in small numbers on the dry pods. The hind legs are much enlarged as in all the *Coreidae;* in the earlier stages this was not marked (Fig. 11).

The total length of a specimen measured was 15 mm.

General Remarks.—The life-history sketched above is a very curious and interesting one. It may be represented thus:—



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The different colour-patterns produced at a moult is instructive. Black seems to be the dominant colour. Black individuals always retain their colour on moulting, except in the last two stages where all individuals once again assume a uniform coloration. The reddish-yellow young on the other hand remain reddish-yellow or change to black. That this variability does not depend on the surroundings or on the food has been already pointed out; and my observations have shown conclusively that it does not depend on sex either.

Such a variability has been also noted by Vosseler (1909) in his classical account of *Myrmecophana* (synonym *Eurycorypha*), the life-history of which is in many ways similar to the one described here. In Vosseler's grasshopper, at the first stage all the nymphs are black; in the next stage a few brown ones appear and in the third stage the number of brown specimens increases and a few individuals of intermediate shade arise. In both cases the ant-likeness gradually vanishes. The variability of coloration also ceases, the individuals all developing a more or less uniform colour.

This tendency to produce differently shaded individuals during the immature ant-like stages seems to me, a very significant phenomenon though no one as yet appears to have drawn attention to it. In places where I have come across numbers of these bugs, breeding under natural conditions on *Cassia occidentalis*, I have also seen different types of ants. Thus *Prenolepis*, some species of *Dolichodorinae*, *Camponotus*, *Solenopsis*, *Plagiolepis*, *Oecophylla* and a few more forms were found on adjacent plants or, quite often, two or three of these types were on the same plant. The ants haunt these plants for the sake of the aphides which live on them or to suck the 'glands' found at the bases of the leaves. It often happens that one form of ant may desert one plant and establish itself on another. *When we consider this variability of the companion ants found on any plant, the significance of this dimorphism becomes evident. In an environment in which either black or the reddish models may be found, or with equal possibility both together, a rigid adherence to one form alone may not be so advantageous as the use of both colour forms as models.* The chances of deception and hence of protection are therefore increased.

It is instructive in this connection to recall the instance of the green and brown larvae of the Large Emerald Moth (*Geometra papilionaria*) mentioned by Prof. Poulton (1890), which resemble the catkins of the birch. There are green and brown larvae just as there are green and brown catkins. Commenting on this, Beddard (1892) says 'Thus a larger number would have a chance of escaping the attention of insect-eating birds than if the caterpillars were all green or brown'. The same argument with even greater force is applicable to the present instance; *the nymphs are dark or reddish-brown just as the ants of the vicinity may be either dark or reddish-brown species.*

That this mimicry is protective is generally accepted. On one occasion I removed a few of these bugs to a plant where there were no ants. After a while I came back to look at them and saw a number of *Attid* spiders each holding a bug in its jaws.

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Evidently the mere ant likeness was no sufficient safety; but it is significant that on plants with plenty of ants these spiders were seldom seen.

The transformation of the typical ant-like nymph into the adult bug without any ant-like appearance is brought about by gradual stages, there is no sudden or abrupt transformation. This is evident from the description given above of each stage. In addition to those points already referred to, mention may be made of one or two others which are of considerable interest since they concern characters which are much used in classification.

The adult *Riptortus* like most *Coreidae* lacks bright colouration and has a disproportionately enlarged third leg with spines on the femora. Its pronotum posteriorly is broader than the head and, in the four-jointed rostrum, the third joint is the shortest and the second the longest. The early nymph however differs from the adult in all these characters. The juicy reddish and yellowish colour of the nymph is not quite inconspicuous; the third legs are normal and the femora bear no spines; the pronotum posteriorly is not broader than the head and in the rostrum the second and the third joints are of equal length.

At every moult there is a short step taken forward in the direction of the adult characters. The third leg shows a gradual enlargement. Thus the ratio of the length of the third leg to that of the first leg is 1·3 in the first stage, 1·5 in the later stages and 1·7 in the adult. The femora of the third leg begins to develop spines from the fourth stage. It is interesting that it is at this stage that the other adult peculiarities also become evident. Thus the thorax loses its cylindrical nature and the tegmina and the scutellum appear. In colouration also, the rich reddish hue of the previous stages vanishes, though still retained by a few, most nymphs put on a dark garb to soon become grayish at the next moult. In the rostrum, the ratio of the second to the third joints is 1 in the first stage, where both the joints are equal, 1½ in the next stage, 1¾ in the third stage and in the fourth stage it is 2, which ratio continues for the succeeding stages. Thus in the fourth stage the adult proportions have been already reached. The ratio of the second joint to the third and the fourth together appears to increase steadily up to the penultimate stage; the ratio are ·4, ·5, ·6, 6·6, ·7 and 7·6 respectively.

Evantissa pulchra.

Evantissa pulchra is a common green mantis found on low shrubs. Its uniform green colour makes it quite inconspicuous on its foliage where it sits quietly watching for any tiny insect that might unwarily get within its grasp. Its cryptic green coloration protects it from its enemies.

Mr. Henry of the Colombo Museum to whom I sent my specimens from Trivandrum for identification informs me that this is one of the commonest mantises of Ceylon.

On the 29th October 1930, I secured a gravid female and kept it in a glass cage. The next day she began to make the egg case

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and to lay her eggs. On the 21st November they hatched. I was not able to observe the actual emergence of the nymphs from the egg case. When I looked at the egg case early in the morning, I was surprised to see a cluster of small yellowish ants covering it. Fearing that the cage was not properly closed and that the ants had got in and were destroying the eggs, I disturbed them to drive them away. To my great surprise I saw that my supposed ants were a number of small mantises, each a very striking imitation of the *Plagiolepis* ant.

This yellowish colouration of the mantis, however, does not last long. It gradually gets darker and darker till in about 15 minutes from the time of hatching it is quite dark. This change is to be looked upon as only due to the chitin which develops normal coloration as it hardens. A dead specimen was also noted to undergo the darkening.

These mantises are perfect mimics of the common black ants, *Camponotus compressus*. The *Camponotus* ants are graded in different sizes which serve the early and grown-up mantises of this stage as models. The young black mantis feeds voraciously and grows fast. As it gets larger the glossy black colouration fades a little. It undergoes its first moult in about three weeks.

In the subsequent stages the ant-mimicry gets less and less pronounced. The colour gradually turns dark-brown and the legs turn greenish. Specimens kept in cages were found to be darker than the individuals of the corresponding stages obtained from the field. The succeeding moults took place within 7 to 12 days till they reached the penultimate stage. In this stage the nymphs are long and stout having the legs and the ventral side of the body, greenish. The dorsal side is still of a light dark colour. Rudiments of the wings are clearly visible. The last moult took place in two weeks.

Evantissa pulchra begins life as an ant-mimic. From the second stage onwards the ant-mimicry is gradually lost till in the adult stage it is green and leaf-like. The life-cycle takes about 10 weeks—3 weeks for the hatching and 7 weeks for the young to attain the adult characteristics.

Transformational Deceptive Resemblance.

In an earlier paper on the life-history of the spider *Myrmarachne plataleoides* (1934) I have drawn attention to those curious transformations noted in the protective methods exhibited by a particular organism in the different stages of its life-cycle. The few instances known to us may fall under three divisions:—

(i) Those, which like Vosseler's *Myrmecophana* (1909) or Hingston's *Isopsera* (1929), begin life as ant-mimics. By gradual steps they lose the ant-likeness and become green and leaf-like, thus depending upon cryptic coloration for protection. *Evantissa pulchra* is an example of this class.

(ii) Those, which like *M. plataleoides* (1934), stick to one method of protection all through life viz. ant-mimicry. To make

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this mimicry effective in different stages of its growth different ants of the suitable sizes are used as models.

(iii) The life-history of *Riptortus* agrees with the first division since it seeks protection by ant-mimicry in the earlier stages and at the final stage loses this ant-likeness and puts on a brownish inconspicuous coloration. But, unlike the instances given under this section, here the ant mimicry is considerably prolonged extending over a number of the earlier stages. During these ant-mimicking stages the nymphs imitate different types of ants of corresponding sizes, as is seen in the second section. To this may be compared Uvarov's account of *Leptoderes ornatipennis* (1922), one of the *Phaneropteridae* from Java. In this insect, the earlier larvae mimic certain tiger beetles of the genus *Collyris* while the later larvae resemble another tiger beetle *Tricondyla cyanea*. The adult is green and leaf-like. The life-history of *Riptortus* however appears to be more varied in imitation of other insects viz. ants,—each stage imitating a different ant and most stages marked by colour dimorphism enabling the individuals of a particular stage to mimic two different kinds of ants at least.

It is interesting to note that these strangely deceptive appearing larvae have been mistaken in many instances for separate insects and named and described as such by different observers. Thus the larva of *Eurycorypha* (Vosseler, 1909) was described as a new genus *Myrmecophana* by earlier workers. Mr. Uvarov has shown (1922) that the early larva of *Leptoderes ornatipennis* was described as *Tricondyla rufipes*, in mistake for a tiger beetle; and that two of the later larvae have also been described as *Condylodera* and *Trochalodera*. The Hemipteran parallel, whose life history is described above, also appears to have succeeded in a similar deception; for most probably it is the larva of one of its later stages, that has been described as a most peculiar bug under the name *Dulichius inflatus*.

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Explanation of Plate.

1-A—An egg attached to the edge of a leaf.
1-B.—An egg after the young has hatched and escaped, showing the moulted skin peeping out of it.
2.—First instar, soon after hatching.

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3. *Prenolepis sp.* the ant which is mimicked by the first instar (2).
4. Second instar.
5. *Plagiolepis sp.* the ant of which (4) is a mimic.
6. Third instar.
7. *Oecophylla smaragdina* the red ant which is mimicked by the third instar (6).

8 & 10. Dulichius stages—the fourth and fifth instars during which they mimic the Camponotus ants.

9. *Camponotus sp.* which is imitated by the fourth instar and to a less extent by the fifth instar.
11. The Adult *Riptortus pedestris*.

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THE ORNITHOLOGY OF TRAVANCORE AND COCHIN.

BY

SĀLIM ALI.

With Notes by HUGH WHISTLER.

PART I.

(With a map, 4 plates and 5 diagrams).

INTRODUCTION.

Since the publication of Hume's[1] and Ferguson's[2] papers on the birds of Travancore, and Kinloch's[3] meagre but tantalising notes on the Nelliampathy Hills (Cochin), considerable advances have been made in our knowledge of the avifauna of Peninsular India, notably through the recent surveys of the Eastern Ghāts and the Hyderābād State.

In order to bring our information concerning the rest of the Peninsula uniformly up to date, it became desirable for a fresh and thorough investigation to be undertaken of that interesting strip of country, occupied by the States of Travancore and Cochin, which forms part of the coastal rain belt at the extreme south-west corner and is comprehensively known as Malabār.

Thanks to the keen interest traditionally taken by them in all matters connected with scientific research and education, the rulers of these States readily recognised the need and granted the facilities necessary for the carrying out of ornithological surveys in their respective territories. In this connection I am especially indebted to the two Dewans, Mr. T. Austin, I.C.S., of Travancore and Mr. C. G. Herbert, I.C.S., of Cochin, to whose sympathetic consideration of the initial representations, the Surveys owe their inception, and to whose personal interest throughout, their smooth and successful working.

It would be impossible here to acknowledge individually all the kindness and help the Surveys received during the course of their work, nevertheless there are some of whom special mention seems called for. Amongst such are Messrs. Dhanakoti Pillai, Conser-

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[1] 'A First List of Birds of the Travancore Hills', by A. O. Hume, *Stray Feathers*, vol. iv, pp. 351-405 (December 1876).
'A Second List of Birds of South Travancore', by A. O. Hume, *ibid.*, vol. vii, pp. 33-39 (August 1878).

[2] 'The Birds of Travancore', by Harold S. Ferguson, *Journal, Bombay Nat. Hist. Soc.*, vol. xv, pp. 249-264 (October 1903); pp. 455-474 (February 1904); pp. 654-673 (June 1904); vol. xvi, pp. 1-18 (December 1904).

[3] 'Rough Notes on the Avifauna of the Nelliampathy Hills', by A. P. Kinloch, *Journal, Bombay Nat. Hist. Soc.*, vol. xxvii, pp. 939-944.
'On the Birds of the Nelliampathy Hills', by A. P. Kinloch, *ibid.*, vol. xxix, pp. 564-565.

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vator of Forests, Travancore; K. Raman Pillai, Divisional Forest Officer, Kottayam; and T. Narayana Menon, Conservator of Forests, Cochin.

Mr. N. G. Pillai, Curator of the Trivandrum Museum, who was attached to the Travancore Survey on deputation and who subsequently volunteered his services in Cochin for as long as his official duties could spare him, also deserves a word of appreciation. The great keenness he displayed in the field is highly commendable, and it is to be hoped that his career may provide him with opportunities of devoting himself to the various ornithological problems peculiar to his part of the country. It is unfortunate that owing to his college term my young cousin Hūmāyūn Abdūlali could not join me earlier than he did in the Travancore Survey. His enthusiasm as a birds' nester contributed materially to this department of the Survey's activities even during the short time he was in the field.

Without the continued and active co-operation of the Bombay Natural History Society it is extremely doubtful if any work of this kind can be successfully undertaken in India. The amount of field research and organised collecting that has been carried out in recent years under the aegis of the Society, despite the universal economic depression, is an eloquent tribute to the push and resourcefulness of the people at its helm. For the Travancore Survey the Society again loaned the services of their skinner and rendered much other help in various ways in return for which their study collections will benefit appreciably.

To Mr. Hugh Whistler who deals with most of the systematic and taxonomic section of this paper and is virtually the author thereof, I wish to express my highest appreciation for his unfailing and continued interest and valued advice in the work of the Surveys. With the vast experience he has recently acquired in handling ornithological material from the Peninsula, it would have been impossible to wish for an abler collaborator. It is also due to him that an extra month's collecting by Mr. Pillai in the environs of Trivandrum town, after the Survey proper had concluded its work in the field, was made possible. Being in July-August, this has enabled us to deduce much useful information concerning the commoner resident birds of that locality.

I am greatly obliged to Mr. B. B. Osmaston, C.I.E., I.F.S. (Retd.), for the trouble he has taken in the preparation of the excellent diagram maps which accompany this paper.

It would not do to close this catalogue of acknowledgments without a mention of the help rendered in more ways than one by my wife. She accompanied the Surveys throughout, often when the travelling and living arrangements left almost everything to be desired, and was responsible for most of the tedious secretarial and writing-up work.

General.

The States of Travancore and Cochin, which adjoin each other, are treated here as one physiographical unit. They comprise the

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southernmost portion of Malabār which, in its widest sense, is the belt of country (rarely over 50 miles broad) lying between the Arabian Sea on the west, and the Western Ghats up to their watershed on the east. It stretches from about Goa to Cape Comorin and encompasses Kanara and Coorg, besides the British district of Malabār. The area here dealt with lies between 8°4′ and 10°45′ N. lat., and 76°14′ and 77°13′ E. long. It is very irregular in shape but roughly triangular, the base being the Arabian Sea coastline. Its greatest length is about 210 miles and greatest width about 75. The combined area of the two States is 9,042·75 sq. miles, Travancore being 7,625 and Cochin 1,417·75.

The western half of the northern boundary is represented by the Shorānūr or Ponnāni River, the eastern half by that curious break known as the Palghāt Gap—a transverse valley which cuts abruptly across the Western Ghats, sharply dividing the Nelliampathies of Cochin from the Wynaad and Nilgiri Hills, and carrying plant species characteristic of the Malabār flora almost across the Peninsula. The frontiers on the two other sides are defined by natural features: all along the west is the Arabian Sea, while on the east the Western Ghāts separate the area from the adjoining British districts of the Madras Presidency—mostly flat and dry except in the western portion of Madūra between about 9°30′ and 10°30′ N. lat., which contains the Pālni, Varūshnād and other hill ranges. In physical characters these latter are essentially the same as the Travancore and Cochin hills and therefore, for the sake of greater completeness, I have included in my notes the gist of Fairbank's[1] and Terry's[2] contributions to the ornithology of the Pālni Hills.

The country exhibits considerable diversity of terrain, but is broadly divisible into three well-defined parts: the hills, the plains and the seaboard. The northern parts, especially where the two States meet, are abrupt and mountainous. Stretching westwards in gentler slopes and gradually widening valleys, but broken here and there by isolated low hillocks, the plains succeed the forest-clad uplands. Intersected by numerous rivers and streams, dotted everywhere by homesteads and farms and closely cultivated wherever possible, these plains extend in a succession of undulations towards a line of backwaters on the coast. In the southern and drier portions, the country closely resembles Tinnevelly, the adjoining Madras district, but is less arid and sterile.

The mountainous character is due to the Western Ghāts, sections of which are known here under different names. From north to south these are as follows:

1. The Nelliampathy Hills with a maximum elevation of about 5,000 ft. comprise a section of the Ghāts which, rising abruptly on the southern boundary of the Pālghāt Gap, extends for some 20 miles south. They lie between 10°26′ and 10°42′ N. and 76°31′ and 76°52′ E.

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[1] 'A List of Birds collected and observed in the Pālani Hills', by Rev. S. B. Fairbank, *Stray Feathers*, vol. v, pp. 387-410 (December 1877).

[2] 'A Few Additional Notes on the Birds of the Pulney Hills', by H. A. Terry, *Stray Feathers*, vol. x, pp. 467-480 (December 1887).

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2. The Annemalāi Hills in the N.-E. portion of Travancore extend into the south-west corner of Coimbatore District on the one hand and northward into Cochin on the other, where they merge into the Nelliampathies. Annāimūdi (8,841 ft.) the highest peak in this range and also the highest in South India (10°10′ N. × 77°4′ E.) in North Travancore, is surrounded by many hills of over 7,000 ft.

3. The High Range, arising in the Annemalāis, includes the Kanan Dēvan Hills. South of these the section is termed Cardamom Hills which in turn merge farther south into Peermade, where the land spreads out in a plateau of considerable width with hills rising up to 5,000 ft.

4. South of the Cardamom and Peermade Hills, which section may be said to terminate at the Periyār Lake, begin the Panthalam (or Pandalam) Hills which run until a gap or pass across them is reached at ca. 9° N. lat., known as the Achankovil Gap.

5. South of Achankovil Gap and of another pass, the Ariānkavū (through which runs the railway line connecting Trivandrum with Madras), the hills continue to within a short distance of Cape Comorin, this section being the Ashāmbū Hills. In the main they consist of a ridge at an elevation of about 4,000 ft. with isolated peaks of which Agāstyāmalāi (6,132 ft.) and Mahendrāgiri (5,427 ft.) are the most important.

From the main range of the Ghāts, which includes all the above sections, rocky spurs run out to the west, in some cases to within a short distance of the sea. From Quilon (8°53′ N. × 76°35′ E.) southwards, these secondary ranges soften down to undulating slopes intersected by glens and valleys which grow wider as the elevation of the hills decreases, and are very fertile.

Owing to the mountainous nature of the country, streams are numerous. They have mostly very winding courses and the majority discharge themselves into the backwaters. The largest river is the Periyār which rises at about 3,000 ft. in the Sivāgiri forests roughly between 9° and 9°30′ N. × 77° and 77°30′ E. and falls into the sea through the backwaters at about 10°11′ N. × 76°10′ E. Near its mouth (in Cochin) it is known as the Ālwaye River. There are other streams of fair size of which the Chālakūdi in Cochin and the Mināchil, Pambiyār and Kodayār in Travancore may be mentioned.

A chain of backwaters and canals extends along the coast from almost the northernmost frontier to Trivandrum. The backwaters are the expansions of the rivers at their mouths, or extensive sheets of water receiving the accumulated flow of several rivers and streams. They are separated from the sea by a bar of sand and silt varying from 7 miles to half a mile in width, with several outlets through which the water is discharged into the sea. The flood tides often overflow the sandbars, raising the level of the backwaters by as much as 2 ft. The total area covered by these backwaters is about 180 sq. miles. The long narrow stretch of sand between them and the sea, as well as their banks, are densely covered with a luxuriant and unbroken growth of cocoanut palms

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which provide the staple produce of the country. In some parts where there are natural or artificial embankments, there is a vast extent of rice fields. The country lining the backwaters is low and generally swampy, and often liable to be flooded during the monsoon inundations.

Climate: Along the coast the climate is equable and damp; the temperature seldom rises above 90° F. or falls below 70° F. At the foot of the hills, the variations range 5 or 6 degrees on either side of the above. On the hills the temperature varies with the altitude, the climate being generally of a moist temperate region. During the winter months the temperature is sometimes 50° to 70° F. during the day, while frost at night is not unknown.

The rainfall is heavy, the greatest incidence being of the South-West Monsoon between May and September. The country, however, gets considerable benefit of the North-East Monsoon as well. The average annual rainfall is as follows: Nelliampathy Hills 150″ and over; Chittūr (in the Pālghāt Gap) 66″; Trichūr 132″; Ernakūlam 102″; Peermade 200″; Trivandrum 66″; Ashāmbū Hills 80-100″. It varies between these limits according to aspect and physical features of the locality.

The mean humidity of the atmosphere is as much as 70 per cent of saturation at its lowest and about 90 per cent at its highest, contrasting with the minimum and maximum in Coimbatore, just on the eastern side of the Ghāts, which are only 52 and 75 per cent, respectively.

The abundant rainfall and excessive humidity are responsible for effects of climate and scenery which find their parallel in Ceylon. The great difference between the southernmost portions of the Indian Peninsula east of Travancore (Tinnevelly District) and Ceylon which is so near it, and the marked similarity of the island to Travancore and the Malabār zone generally, are a curious feature of Indian physiography. All the physical aspects of the Nilgiris, and the Annemalāis and other Travancore-Cochin ranges are repeated in the highlands of Ceylon.

Forests: The forests of Travancore-Cochin are divisible into four classes, as follows:

1. Heavy moist evergreen, confined to the Ghāts (chiefly the western slopes) and ravines, and perhaps to one-third of the upper hill plateau.
2. Land originally covered with evergreen forest, but now overgrown by secondary scrub jungle of various ages.
3. Deciduous forest with grass growing under the trees, which covers the ridges and the higher ground and a part of the hill plateau.
4. Rock and stony land covered with short grass.

Peculiarities of the Fauna of Travancore-Cochin.

As has been observed before by Ferguson (*J.B.N.H.S.*, vol. xv, p. 249) there is a curious but marked similarity between the vertebrate animal life of Travancore-Cochin (in fact of all the heavy-rainfall zone or belt herein treated of under the comprehensive term Malabār) together with the south-western hilly regions of

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Ceylon on the one hand, and that of the Himalayas (especially from the east of Nepal to the extreme North-Eastern frontier of British India, and beyond into Yūnnan and Western China), Assam, Burma, Tenasserim, Siam, Malay Peninsula extending often into Java, Sumatra, Borneo and adjacent islands on the other. The same applies to insects and many of the other invertebrate forms as well.

Before attempting to analyse these remarkable affinities and parallelisms in areas often separated by stretches of 1,500 miles or more of intervening country over which the forms are absent, and investigating the causes and factors which may help to explain the origin and continuance of these isolated colonies, it will be necessary first to enumerate some of the more outstanding examples exhibiting these distributional peculiarities.

Among Mammals, the Tahr (*Hemitragus*) and the Marten (*Charronia flavigula*) will suffice.

Hemitragus nilgiriensis: The Nilgiri Tahr, or 'Ibex' as it is popularly misnamed, is found in a section of the hills of South-Western India from the Nilgiris down through the Nelliampathies into the Annemalāis to about 10° N. lat. Over 1,000 miles separate it from the only other Indian representative of the genus viz. *Hemitragus jemlaicus* the Himalayan Tahr, whose range is from Kashmir to Bhutan. A third species, *H. jayakari*, also lives in an isolated colony in the hinterland of Oman (Arabia). These animals inhabit mountainous country with cliffs and precipices.

Charronia flavigula: Found throughout the Himalayas from the Hazāra country to the eastern extremity of Assam at elevations of not exceeding 7,000-8,000 ft., also through the hilly parts of Burma, Malay Peninsula and Sumatra; South China and Amūrland.

In the Peninsula of India this Marten occurs in the higher portions of the Western Ghāts south of the Nilgiris, and in the Travancore ranges. It is also said to be found in the Ceylon hills.

Among Reptiles a prominent example is furnished by the genus of Flying Lizards, *Draco*. It is represented by 3 species ranging from Assam to Yūnnan, down through Tenasserim and Siam to Singapore and probably still farther south into the islands of the Malay Archipelago. A fourth species, *Draco dussumieri*, occurs in Malabār, Cochin and Travancore.

Ixalus, a beautiful little tree-frog, is a notable instance of discontinuous parallel distribution among Amphibians. The genus is found in Borneo, Malay Peninsula, Burma and Eastern Assam. It is well represented (by at least 6 species) in the wet Travancore hills, and probably elsewhere in similar facies in the Malabar monsoon zone.

Coming to our own group, Birds, we find that instances can be multiplied many fold. In the following I have selected some of the more outstanding examples: the species occurring in the Himalayas, Assam, Burma, Tenasserim, Malay Peninsula and Islands, are enumerated first, followed by their representatives living in isolated colonies within the Malabār zone as above limited, and in Ceylon.

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Genus *Garrulax*[1]: Laughing Thrushes.

(Forest-frequenting birds, found from the level of the plains up to about 9,000 ft. but usually to 4,500 ft., varying with locality and species.)

Represented within Indian limits by 6 species in 12 geographical races, inhabiting the Himālayās from the Hazāra Country in the west to the North Chin and Kachin Hills on the east; Assam, Cachar, Shan States, Central Burma, Pegu, Tenasserim. Outside our limits, it extends to Yūnnan, Hainan, Siam, Annam, Cambodia, Malay Peninsula, Sumatrā, Borneo and other islands of the Malay Archipelago.

An isolated seventh species *Garrulax delesserti* occurs in South India, its distribution being confined to the hills of Wynaad to South Travancore. It is absent in Ceylon.[2] The distance separating *G. delesserti* from its nearest congener in the other areas is 1,000 miles in the Himalayas, and 1,500 miles across the Bay of Bengal in Burma.

Genus *Trochalopteron*: Laughing Thrushes.

(Forest-frequenting birds, found at elevations over about 4,000 ft. They have obviously some biotic connection with the wild Raspberry, *Rubus*,[3] at least in Southern India, the distribution of which plant exhibits parallel peculiarities. In the hills of the Malabār zone *Rubus* is met with only at elevations above 3,500-4,000 ft. Immediately this altitude is reached and *Rubus* appears, *Trochalopteron* may be confidently looked for.)

Represented in Northern India and the Eastern Peninsula by 11 species in 27 races, from the frontier of Afghanistan on the west, right through the Himalayas to the Mishmi Hills and the extreme North-East Frontier, and beyond. (Quetta and Ziarat in Baluchistan, North-West Frontier Province, Chitral, Gilgit, Hazara Country, Murree, Kashmir, Tibet, Garhwal, Kumaon and Simla Hills, Nepal, Sikkim, Bhutan, etc.) The genus is found

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[1] As there is disagreement among different authors regarding the scope of the genus *Garrulax*, it might here be explained that in the above it has been limited as accepted in the *New Fauna*.

[2] It is a matter of opinion whether the genus is represented in Ceylon or not. *Turdoides cinereifrons* of the *Fauna* was formerly reckoned a *Garrulax* and originally named by Blyth as such. Mr. Whistler indeed considers it so extremely close to *Garrulax* that he even compared it with *delesserti* to see if they could be considered subspecies of each other! He himself would prefer to consider it a *Garrulax*.

[3] Of the 41 species of this Genus admitted by Hooker in the Flora of British India, mostly confined to the Himalayas, Assam, Burma, etc., and growing at altitudes of over 3,000 ft., four are recorded from Ceylon. Three of the latter are found in the hills of South India, one, *R. ellipticus*, also occurring from the Western Himalayas to Burma. It is significant that in Ceylon, *Rubus moluccanus* var. *macrocarpus*, contrary to the habitat of the genus descends as low as 1,000 ft. A species of *Oreocincla*, endemic to the island, viz., *O. spiloptera*, contrary likewise to the habitat of its congeners elsewhere, descends in its distribution to about the same low level.

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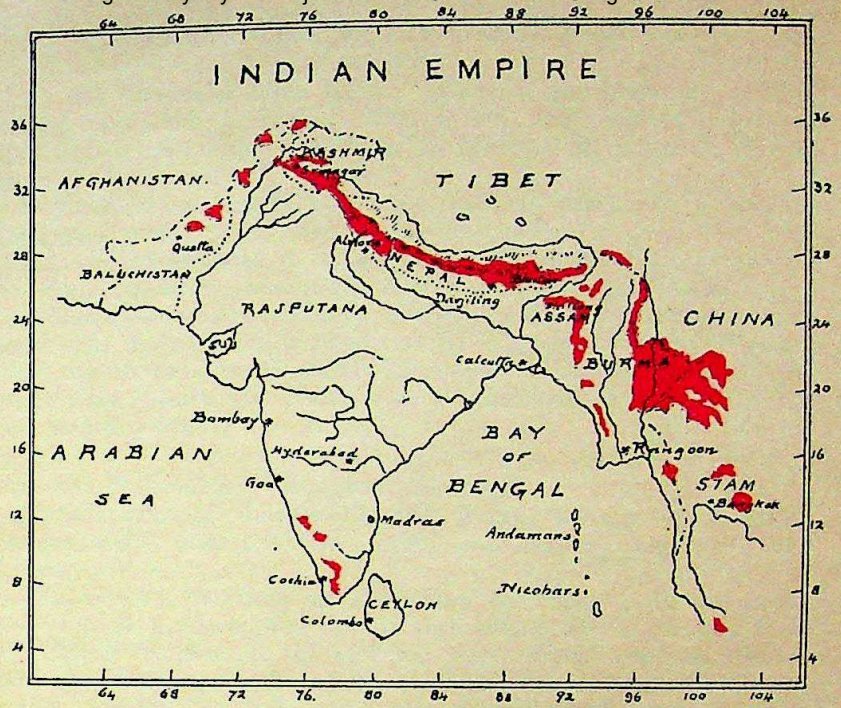

Fig. 1. The distribution of the genus *Trochalopteron* (Laughing-Thrushes) in the Indian Empire.

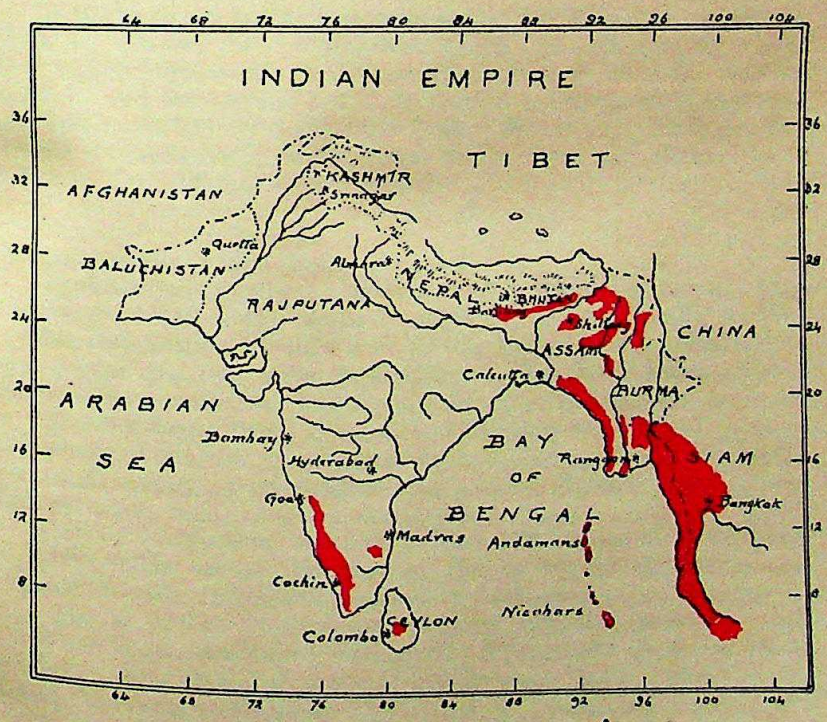

Fig. 2. The distribution of the Fairy Blue-bird (*Irena puella*) in the Indian Empire.

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in all the Assamese Hills (Dafla, Mikir, Naga, Manipur, Lushai, Khasia) and the Burmese Hills (Chin and Kachin), Arakan, Shan States, Karenni, and down to Muleyit Mountain in Tenasserim.

Beyond Indian limits the genus extends eastward to Eastern China and southward to the Malay Peninsula.

In Peninsular India it occurs in the Malabār zone in 2 species viz. *Trochalopteron cachinnans* and *T. jerdoni*, the former having 2 (*? cinnamomeum* extremely doubtful!) and the latter 3 local races. Its distribution is confined to a section of the Western Ghāts which is almost exactly coincident with the range of the Nilgiri Tahr. Like the Tahr also, it does not extend to Ceylon. (See diagram map.)

Genus *Oreocincla*: Mountain Thrushes.

(Inhabitants of hill-forests and sholas, usually at elevations between 2,000 and 4,000 ft.—often considerably higher in the Himalayas.)

Represented in Northern India and the Eastern Peninsula by 3 species in 5 races, distributed throughout the Himalayas from the Afghan frontier on the extreme North-West, over the Hazara Country, Chamba, Kashmir, Garhwāl and Simla Hills, Nepal etc. to the extreme North-East frontier, and beyond into Yūnnan, Annam and Siam. It also occurs in the Chin and Kachin Hills, North and South Shan States and in the mountains of Central Burma to Tenasserim.

In South-West India it is represented by a race of the Himalayan *O. dauma*, viz., *nilgiriensis*, which occupies the hill ranges from the Nilgiris south to Central Travancore at altitudes between 2,000 ft. and the highest hills. In Ceylon a third race of the same viz. *imbricata*, inhabits the hills from 3,000 ft. up, while another species *O. spiloptera*, found from the level of the Plains up to 4,000 ft., is endemic in the island.

Irena puella: The Fairy Bluebird.

(Typically an inhabitant of evergreen jungles and sholas, from almost the level of the plains to 4,000 ft. or occasionally higher.)

The distribution of this bird within Indian limits, confined to one species and two races, is significant. In North India and the Eastern Peninsula the longer winged race *sikkimensis* is found in the Himalayas from Sikkim and Bhutan to Eastern Assam; the whole of Burma (in the wet forests) and south to the Malay Peninsula (where it intergrades into a third Malayan race *cyanea*) and east into Siam, Annam and Cochin China.

With an intervening break of at least 1,200 miles to Sikkim and of 1,000 miles across the Bay of Bengal to the Andaman and Nicobar Islands the species makes its appearance (in the typical race *puella*) in the Chitteri and possibly adjoining hills of South Arcot and thence westward, presumably through the Shevaroy Hills, into the rainy Malabār zone of South-West India. Here it inhabits the evergreen jungles and sholas of Travancore, Cochin, the

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Nilgiri and adjoining ranges, extending northward to Kanara.[1] (See diagram map.)

Genus *Arachnothera*: Spider-Hunters.
(Birds of tropical and sub-tropical rain forests.)

Represented in the Himalayas and the Eastern Peninsula by 4 species in 5 races distributed from the Sutlej Valley to the extreme south and east of Assam, and through Burma, Tenasserim and the Malay Peninsula down into Sumatra, Borneo and neighbouring islands. Also Yūnnan, Siam, Annam, Cochin-China, etc.

The distribution of one species and race, *Arachnothera l. longirostris*, is remarkable. It occurs in eastern and southern Assam, E. Bengal (Tipperah), Chittagong, the hill-tracts from Manipur to the Chin Hills; Shan States and Burma south to the whole of the Malay Peninsula, Siam, Annam and Cochin-China.

After a break of over 1,000 miles from its nearest inhabited area, *A. l. longirostris* re-appears in the extreme south-west of the Indian Peninsula where it ranges from South Travancore, north through the Nilgiri and Palni Hills to the forests west of Belgaum.

Genus *Hemicircus*:
(Small woodpeckers inhabiting dense deciduous forest on the verge of evergreen jungle, i.e., the transition zone between deciduous and evergreen.)

Represented by 2 species in 2 races in Assam, Burma, Tenasserim, Malay Peninsula, Siam, Cochin-China and Annam.

A third race—*Hemicircus canente cordatus*—is confined to the the Malabār zone of S.-W. India.

Genus *Macropicus*: The Great Black Woodpecker.
(Inhabitants of mixed evergreen and deciduous forest.)

Represented by 1 species in 2 races in Burma from Northern Shan States to Tenasserim, Malay Peninsula, Borneo, Sumatra, Java, Bali, etc. A second species—*M. hodgei*—is restricted to the Andaman Islands.

In S.-W. India a third race of the continental species, namely *Macropicus javensis crawfurdi* occurs in the Malabar zone from Travancore to Belgaum.

Genus *Vivia* (*Picumnus*): Speckled Piculets.
(This genus has several species in South and Central America (?) but only a single—*innominatus*—in the Old World.)

The above species, in 2 races, ranges in the Himalayas from Kumaon to Assam, Karen Hills, Shan States, Burma, Tenasserim, Annam, Siam, Malay Peninsula, Borneo, Sumatra, etc.

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[1] There is no record of this species in Khāndesh and it of course does not occur there. The most northerly record in this area is for Sāvantvādi (near Goa) where a single specimen was obtained by Mr. Crawford's shikari (S.F., ix, 65). Butler says that a Mr. Laird obtained it in the 'forests south-west of Belgaum' (S.F., ix, 403) and it is of course common in suitable forests in North Kanara. The extension to Khāndesh is one of the inaccuracies entirely typical of the *New Fauna*.

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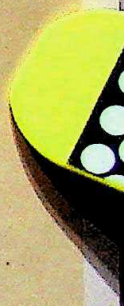

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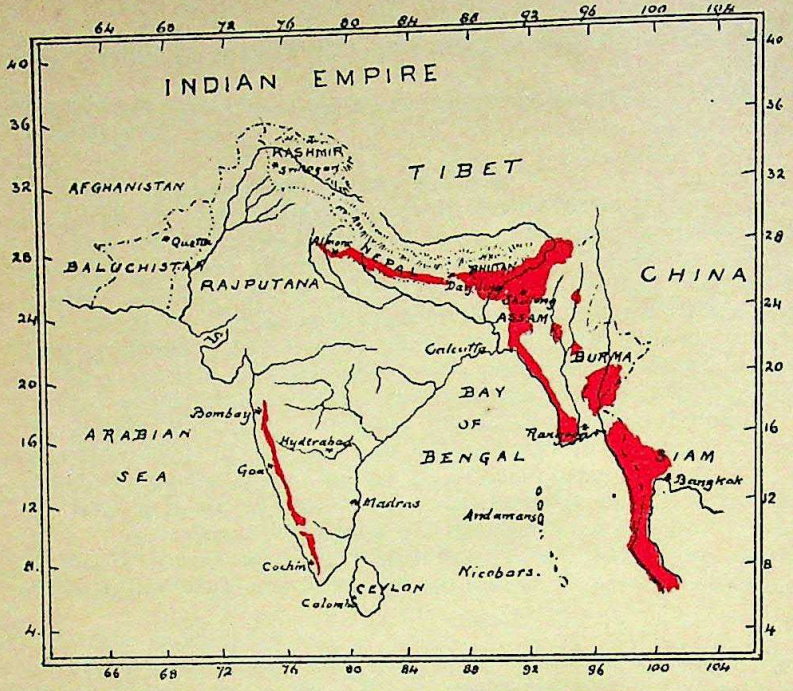

Fig. 3. The distribution of the Great Hornbill (*Dichoceros bicornis*) in the Indian Empire.

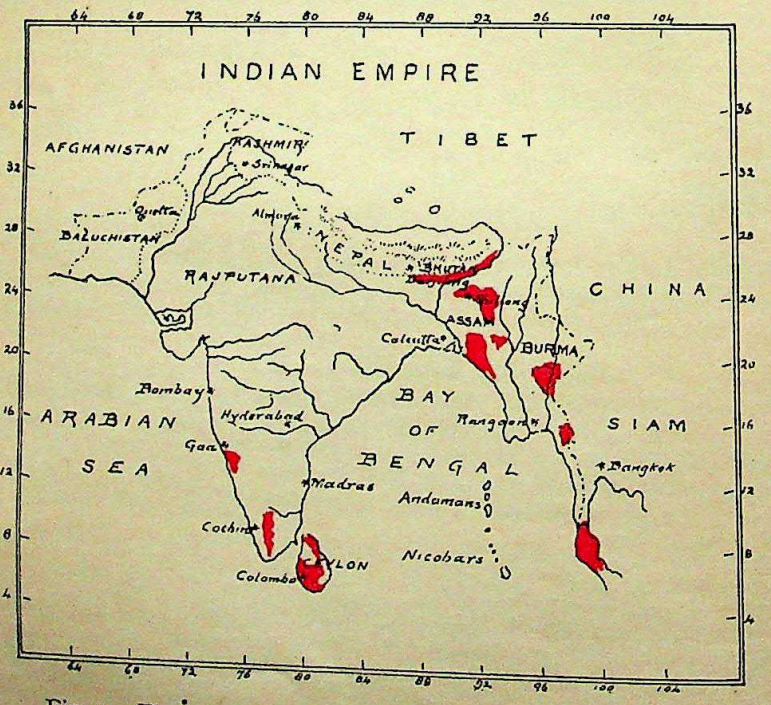

Fig. 4. The known distribution of the genus *Batrachostomus* (Frogmouths) in the Indian Empire.

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In S.-W. India a third race, *Vivia innominatus avunculorum* (Hartert), inhabits the Travancore, Wynaad and Nilgiri hills and as far north as the Sirsi Taluka of N. Kanara.

Genus *Alcemerops*: Bearded Bee-eaters.
(Birds of rain forest country, up to 5,000 ft.)
Represented by 2 species in the lower Himalayas from Dehra Dun to Eastern and Southern Assam and down through Burma, Siam, Malay Peninsula to Sumatra, Borneo, etc.
One of these species—*Alcemerops athertoni*—after a break in its distribution of well over 1,000 miles, occurs again in S.-W. India (Malabār zone) from Travancore to Belgaum.

Dichoceros bicornis: The Great Indian Hornbill.
(Typically a bird of the tropical and sub-tropical rain forests of Asia.)
Distributed in the Himalayas and Eastern Peninsula from Kumaon to Eastern Assam, Chittagong, Burma (wet portions), S.-W. Siam, Malay Peninsula to Sumatra, Borneo, etc.
Occurs in S.-W. India in the Malabār zone, separated from the rest of its range by at least 1,000 miles of intervening country. (See diagram map.)

Genus *Hirundapus*: The Spine-tail Swifts.
(Residents of rain-forest country.)
Represented by 2 species in 3 races over the Himalayas from the Hazara country to the extreme N.-E. Frontier; hills of Assam, Burma, Malay States and Cochin-China. The genus extends farther to Java and neighbouring islands.
Hirundapus giganteus indicus also occurs in the Malabar zone, an area separated from the rest of its range by over 1,000 miles.

Lyncornis cerviniceps: The Great Eared Nightjar.
(Birds of the lower hill forests, most commonly below 3,000 ft.)
Represented by the typical race *L. c. cerviniceps* in Eastern Bengal and Assam, Burma, Malay Peninsula and S.-W. Siam. Various geographical races of this species (or probably a second also) are found right up to New Guinea.
A race of *L. cerviniceps*, viz., *bourdilloni*, is confined to South and Central Travancore only.

Genus *Batrachostomus*: The Frogmouth.
(Closely allied to the Australian genus *Podargus* which is found over the greater part of the Australasian region. Birds of deep evergreen forest.)
Represented by 2 species in the Eastern Himalayas from Sikkim to the N.-E. Frontier; Assam, Burma, Malay Peninsula, Peninsular Siam, Java, Borneo, etc.
A third species—*Batrachostomus moniliger*—is common to Ceylon and the Malabar zone. (See diagram map.)

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Genus *Huhua*: Eagle Owl.
(Dwellers of heavy jungle.)
Represented by 2 species in the Himalayas from Kumaon to Eastern Assam, Burma, Tenasserim, Malay Peninsula, Sumatra, Java, Borneo, etc.
One of the above species—*Huhua nipalensis*—also occurs in the forests of the Malabār zone from the Nilgiris through Travancore to the hills of Ceylon.

Genus *Baza*:
(Birds of deep well-watered forests. Found in Africa, Madagascar, the Oriental Region to Australia.)
1. *Baza leuphotes*: The Black-crested Baza.
Represented by 2 races from the Nepal Terai to Eastern Assam, Burma, Siam, Indo-China and N. Malay Peninsula.
One of the above—*Baza leuphotes leuphotes*—is also found in Travancore and Ceylon.
2. *Baza jerdoni*: Jerdon's Baza.
Represented by the typical race *jerdoni* from Sikkim to Eastern Assam, Burma, Malay Peninsula to Sumatra.
A second race—*Baza jerdoni ceyloncnsis*—occurs in the Malabār zone and Ceylon.

Besides the above, numerous other examples from almost every endemic family could be cited which exhibit the same distributional peculiarities in a greater or lesser degree. Some of these are: *Microscelis, Eurystomus, Alcedo meninting, Ceyx tridactylus, Sauropatis, Anthracoceros, Collocalia, Phodilus badius, Ninox scutulata, Ictinaëtus, Spizaëtus, Accipiter virgatus, Ducula badia, Muscadivora, Chalcophaps, Gorsakius.*

To the question of the origin of these isolated South Indian and Ceylonese colonies we shall revert later. In the meantime let us first consider, one by one, the factors that seem most important in giving rise to and maintaining the parallel environmental conditions which conduce to the existence of so many specialised forms in such widely sundered areas.

Geology.

Some general remarks on the Geology of India seem called for in order to convey a proper idea of the physical features and their resultant effect upon the meteorology of the country, particularly of the tracts here concerned.

Peninsular India is an example of a solid land mass which has neither been folded nor disturbed since the earliest geological times. South of the Gangetic 'Valley' and of the Vindhyan Range, the country, except for some places near the coast-line, has not been under the sea. Its orographical features therefore, are merely the outcome of differential erosion. The square-cut, deep-sided hills of the Deccan proper, composed of horizontal layers of lava flows, are of what is known as the 'relict' type, caused by the toning down of intervening portions of a once continuous plateau by long exposure to the weather. The

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shallow open valleys, with rivers near their base level of erosion, and the gently undulating plains are all the result of this process.

In contrast with this stable land mass of the Peninsula proper, the extra-peninsular area, i.e., the land lying to the west, north and east of the Indo-Ganegtic alluvial plain (viz., Sind, Baluchistan, the Himalayan Mountain belt, North Assam and Burma) provides abundant evidence of repeated submergence beneath the ocean, marine fossils being in some cases found as high up as 20,000 ft. above sea level. The Himalayas are the result of the folding of the Earth's crust and its elevation due to pressure from the north, during the latest geological period.

After the Palæozoic era, and during the secondary stage of elevation, while ocean currents swept from the Persian Gulf to the Aravalli Hills (the oldest of all Indian physical features), the rock area of the Peninsula extended over Assam and the Eastern Himalayas, while Burma, the North-West Himalayas and the uplands beyond the Indus were still submarine or undergoing alternations of elevation and depression. The North-West Himalayas, Tibet and Burma were gradually upraised and fashioned during the epoch at the close of the Cretaceous period; but there is evidence to show that Burma is a much more recent geographical feature than the North-West Himalayas which were formidable mountains even in Pliocene ages. The Andamans and Nicobars have been isolated from the Arakan coast by submergence at a probably recent date.

Geological science inclines to the opinion that the elevation of the Western Ghats to present altitudes was comparatively recent. The steep-sided narrow valleys where the streams are still cutting their way back to their sources and gradually working their beds down to a permanent level, appear to be in the same stage of development as those of the extra-peninsular region. One result of this process of evolution has been that nearly all the great rivers of South India take their rise in the Western Ghats and flow across the continent to the Bay of Bengal. The Nerbadda and Tapti alone cut their way in deep channels westward, and there are indications further south that a great third river may once have found its way to the Indian Ocean across the continent through the Pālghāt Gap. The inference drawn by geologists from the general distribution of the hydrographical features of India seems to be that the peninsula as we now know it, is but the eastern half of a far wider land area of which the main water-parting was nearly if not absolutely coincident with that of the Western Ghats, and that the rivers flowing westward therefrom have disappeared with the land which they intersected.

The geological history of Travancore is the same as that of the rest of the Madras Presidency and the greater part of Ceylon. This is also the case with Tenasserim, most of the rocks found there being similar to those met with in Travancore and the Madras Presidency.

Investigations in other parts of the Globe, viz., Africa, Madagascar, Australia, and even South America, have brought to light

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an exactly parallel group of continental formations exhibiting much the same physical as well as organic characters (Gondwāna System). It is argued from many palaeontological discoveries in the Cretaceous Systems of Africa and India that an unbroken land connection existed between these regions, across what is now the Indian Ocean, in a large southern continent which extended from West Africa to Ceylon and South India and possibly united within its boundaries the Malay Archipelago and Australia as well. The presence of such terrestrial mammals as the *Lemuridae* in the Indo-Malayan Region on the one hand and in Madagascar on the other, seems difficult to account for in any other way, and is generally cited as one of the proofs for the existence of a land connection sufficiently continuous to bring about the present peculiarities of distribution. It is postulated that the intervening land mass has since subsided under the ocean, the submerged Indo-African continent being termed Lemuria.

There is also a certain amount of typically Indian element in the avifauna of Madagascar which seems to have been severed from Africa even in the early Tertiary epoch. Sedentary forms such as *Copsychus*, *Microscelis* and *Ninox* may be considered as undoubted examples. In Mauritius the incursions of the Indian avifauna appear to be *Collocalia*, and *Palaeornis* (*Psittacula*) while in the island of Réunion, the parrot *Mascarinus* possesses undoubted affinity to our Indian *Psittacula*. The presence of all these forms lends further support to the theory of the Lost Continent.

The bird-life of Africa is now cut off from that of India by the arid belt of North Africa which stretches across Arabia and Baluchistan to Sind and Rajputana. There is overwhelming evidence that both these regions were once connected by a forest belt which permitted an exchange of forms. Presumably Africa got the following in this manner: *Bucerotidae*, *Eurylaemidae*, *Treronidae* and the genera *Palaeornis* (*Psittacula*) and *Pitta*, furnishing in return *Indicator* and *Salpornis* (**13**, p. 656).

It was in the early Tertiary or the end of the Cretaceous period that Gondwānāland (which included Lemuria), the most prominent feature of the Earth's Mesozoic geography, finally broke up and the Peninsula of India acquired its present restricted form. Incidental to this change a profound redistribution of land and sea took place in the Southern Hemisphere. Few geographical changes of any magnitude have occurred since these events and the triangular outline of South India acquired then has not been altered since to any material extent.

While there is little in the geological history of the Malabār zone on the one hand and the areas to which its fauna so closely approximates on the other to suggest any *direct* influence of this factor in the existence of such convergence, yet it is undoubtedly the geological movements and evolution that are responsible for producing physical features which, by regulating meteorological conditions, have produced parallel environments adapted to the existence of peculiar and parallel forms of life in these widely sundered areas.

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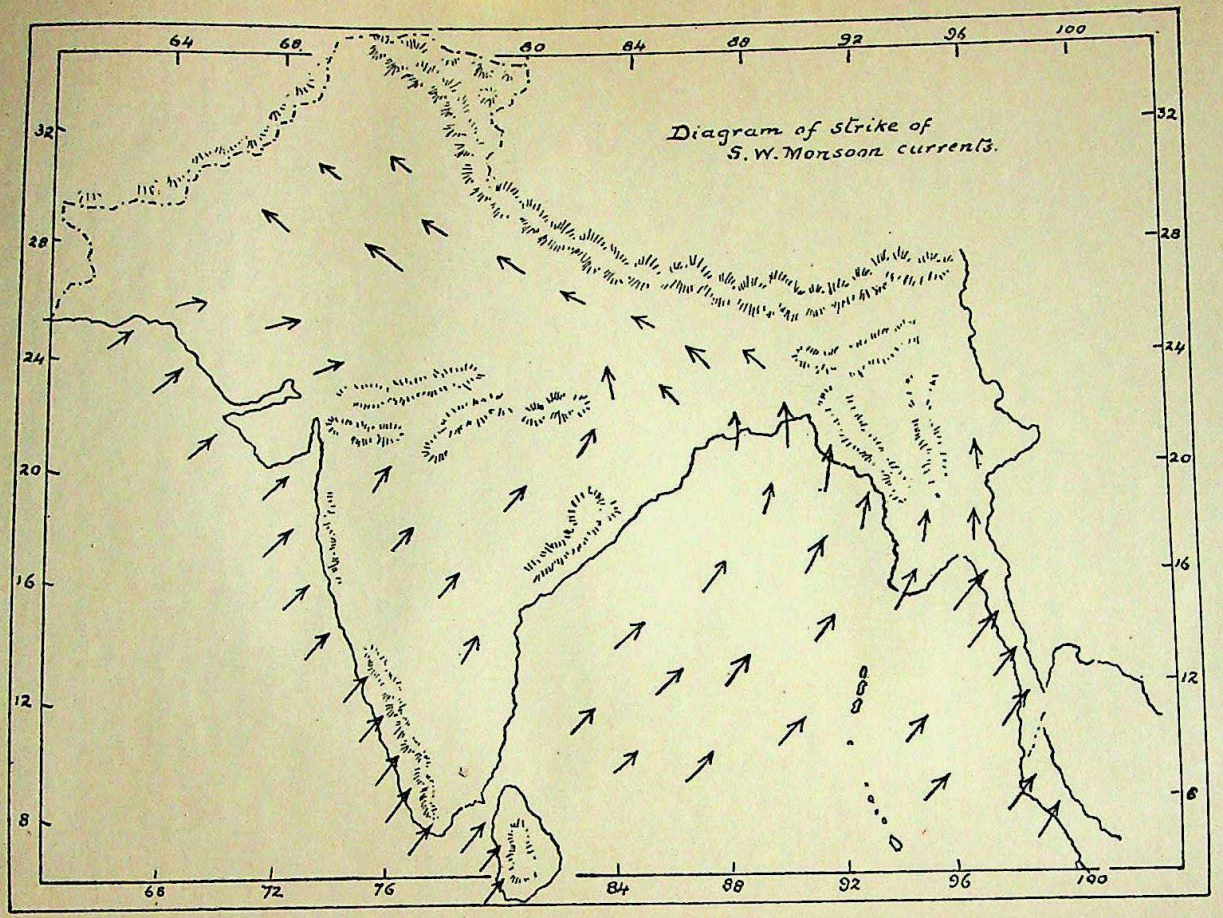

Map to illustrate the strike of the S.W. Monsoon currents in the Indian Empire.

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Meteorology.

The physical and geographical features of India are of great importance in so far as they modify more or less considerably the lower air movement, and hence the distribution of temperature, humidity and rainfall.

Its northern districts are more excessive in climate than the southern because they are broader expanses of land, and the western side of the Peninsula is more equable than the eastern because it is much more humid. The great extent and elevation of the high land in South Ceylon powerfully influences the meteorology of the whole island.

For our purpose it will suffice to consider only the conditions that produce the excessive humidity and heavy rainfall common to the tracts under discussion, for as is well known, the principal factor which regulates vegetation is rainfall, the quantity and distribution of which, controlled by the physiographical characters of the locality, decide to a great extent the nature of its most important plant formations. Analysis shows that it is the similarity of the physical features of the Malabār zone and of S.-W. Ceylon on the one hand, and those of the Eastern Himalayas, Assam, Burma, Tenasserim, Malay Peninsula and Archipelago on the other that is primarily responsible for producing more or less parallel conditions of climate.

By far the greatest amount of rainfall is precipitated during the South-West Monsoon. The heated atmosphere over the Indian land mass and beyond in Central Asia ascends during the hot season giving rise to a low pressure area which is rapidly filled by oceanic air currents from the Arabian Sea and the Bay of Bengal, of great volume and elevation and heavily charged with aqueous vapour. One of the main causes that determine the distribution of rainfall during the season of the South-West Monsoon (May to September) is ascensional movement due to forced ascent across natural barriers. Such forced ascent across or against hill-ranges into the cooler and higher atmospheric strata enveloping the heights results in condensation of the moisture-laden vapour and produces heavy rainfall in (*a*) Malabar, the Konkan and Gujerat (?); (*b*) Ceylon; (*c*) Tenasserim and Arakan; (*d*) the Assam Hills and Sylhet, the lower Himalayas and submontane districts, more especially in the eastern half. The portion of the Himalayas west of about Sikkim is not exposed to the full burst of the annual monsoon currents. The Bay current advances towards them, but is deflected, and though there is much ascensional movement, it is not forced ascent accompanying movement across the line of hills. Hence the distribution of the rainfall here does not follow the same law as in the Western Ghats or the Assam Hills, neither is it on the whole so heavy.

The North-East Monsoon (November to January) which produces rainfall of considerably less extent, also reacts to the hill ranges of Assam, Burma, Ceylon and South India in the same way. It is caused by the high-pressure system which develops in Central Asia at this season and the consequent outflow of the cooled

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air towards the Equator. Travelling over vast spaces of dry land it is not charged with much moisture. Such rain as falls at this period in the North-Eastern parts of India is mainly the result of the driving back against the mountain barriers of the moisture-laden winds of the South-West Monsoon that have escaped undischarged. A certain amount of moisture is collected by the winds in travelling over the Bay of Bengal, and the winter rains in the Southern part of the Peninsula are due to this. On the Pālni, Nilgiri, Annemalāi and other Travancore and Cochin Hills the amounts registered during the months from October to December are about two-thirds of the fall received during the last 2 months (August and September) of the South-West Monsoon.

We find, therefore, that climatologically the Malabār zone, Ceylon, the Malay Peninsula, Tenasserim, parts of Burma, the Eastern Himalayas and Assam present very similar features as regards the Monsoons especially the South-West which is by far the more important of the two. On account of the similarity of physical features and relative geographical position, the South-West Monsoon currents strike the seaward faces of all their hills directly and all these areas consequently receive heavy rainfall at that period. (See diagram map.)

Vegetation.

The distribution of a flora depends chiefly on geographical and climatal features, especially rainfall and humidity. Plant formations, besides, are also influenced by aspect, by the composition of the soil and by the depth of the permanent sub-soil water supply, all of which influences account for the appearance of species (covering it may be large areas) in zones generally deemed unsuitable to their growth.

In the previous section it was seen how similarity in physical features and geographical situation has combined to influence the main factors in the meteorology of the widely separated areas under consideration, and to give rise to the moist and humid conditions common to all of them. It now remains to analyse some of the more outstanding features in the vegetation of these areas to see whether, and how far, the similarity in climate has resulted in discontinuous but parallel distribution of plant formations and associations.

The abrupt western face of Malabār, especially towards the south, is clothed with a luxuriant forest vegetation in which there is a marked preponderance of Malayan types over those of the adjoining Deccan area. Travancore and Cochin, isolated by natural barriers, present a remarkable similarity to Ceylon in position and many features of topography, climate and vegetation. The botanical featues of the island, as may be expected, coincide with its physical. The moist mountainous southern and south-western districts have a flora of the Malabār type though showing even more Malayan affinities, and the hot dry northern districts one of the Coromandel type. It may be mentioned here that there is a marked resemblance between the northern districts of Ceylon and

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those of Madras east of the Malabār Ghats (viz. Madūra and Tinnevelly) on the one hand, and Egypt on the other. The umbrella-shaped *Acacia planifrons*, confined in India to the above districts, is common to both these regions while the prevalence of *Cocculus Leaeba* and *Capparis aphylla*, the production of fine cotton and the best Senna (*Cassia obovata* and *C. angustifolia*) enhances the similarity.

Though tropical Asia and Africa are now separated by a vast expanse of ocean, there is a striking similarity in their vegetation, both in the annual forms that spring up during the rainy season and in the families and genera of trees and shrubs, e.g., *Capparis*, *Grewia*, *Sterculiaceae*, *Acacia*, *Rubiaceae*, etc.

Densely wooded gorges known as *Sholas*, similar to those of the Nilgiris, occur in the Annemalāi, Pālni and other ranges of the Malabār Ghats south to Travancore and also in the highlands of Ceylon. These sheltered and wooded dells, which are a feature of the Khāsia and other Assam and Burma hills as well, possess a vegetation which closely resembles that of similar spots in the Eastern Archipelago and contain many representatives of the Malayan flora such as *Ternstræmiaceæ*, *Rhododendron arboreum*, *Vaccinia*, *Gaultheria*, *Symplocos*, *Michelia*, *Goughia* and *Gomphandra* which seem equally frequent at analogous elevations.

Notwithstanding the enormous precipitation and great humidity the upper parts of the Nilgiris, Travancore-Cochin and other South Indian hills, as well as those of South-West Ceylon, are characterized by the presence of expanses of open undulating grassland, generally bare of trees. This curious anomaly is due partly to the nature of the surface and the free drainage, but mainly to the removal of the soil by the heavy rains and to the furious winds which sweep over the level tops of the hills. It is a feature that is also repeated in the Khāsia and other hills of Assam.

The most interesting feature of the Nilgiri flora as a whole and that of the Malabār Ghats and the Ceylon hills, is its affinity with the cool regions of the far distant Khāsi, Manipūr, Nāga and other hills of Assam and North Burma. Many trees and shrubs are common to these two localities, and most of them to the temperate Eastern Himalayas as well. The herbaceous plants are particularly numerous. Hooker and Thomson (7, p. 104) remark: 'Constantly during our examination of the temperate as well as the tropical plants of the Nilgiri, Khāsia, Ceylon and the Himālayā, we find them identical in species with Javanese mountain plants. . .' 'Besides *Gaultheria nummularia* found in the Javanese mountains but extending from N.-W. Himalayas along the whole Himalayan range and in the Khāsia Mountains; also probably in the mountains of the Malay Peninsula and of Sumatra (over 3,000 miles), there are many other Java plants spread over the hilly districts of India and Ceylon.'

Enough has been said to show that the great similarity in the areas under consideration (namely Malabār zone, Ceylon, the Eastern Himalayas, Assam, Burma, Tenasserim, Malay Peninsula, Sumatra, Java, Borneo and probably farther east) though often widely separated, is not merely a haphazard circumstance but

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based upon an obvious and demonstrable concatenation of ecological conditions brought about by analogous natural causes. It is not surprising therefore, that scrutinized further, the links in this symbiotic chain should be found to be equally well-forged. The similarity of physical features accounts for more or less identical climatic conditions, which in turn are responsible for parallelisms in the vegetation. Similarity in plant-life conduces to a similarity in the insect forms dependent upon it, while these again have similar hosts predatory on them, and so on through divers ramifications *ad infinitum*.

It has hitherto been believed that the distribution of bird-life was controlled directly by climatic conditions, but we now begin to realize that it is not so much the bird itself but its most important vegetable or animal food that is dependent upon such conditions. The distribution for instance of the kingfisher *Alcedo atthis* on its northern boundary is controlled by the winter isotherm which precludes the possibility of its obtaining fish food in the frozen rivers and streams of Northern Siberia. We also realise now that many species of birds are wholly dependent for their distribution upon the distribution of particular plant-formations and animal associations.

While it is clear that the existence of homogeneous animate forms in widely sundered areas is explainable by a careful scrutiny of analogous natural conditions, the *origin* of their presence in such isolated colonies as those in Travancore-Cochin and Ceylon on the one hand and in the Eastern Himalayas, Assam and Burma hills or Tenasserim on the other must be sought directly in the geological history of the Earth.

Origin of Discontinuous Parallel Distribution.

Hooker and Thomson (7, p. 37) are of opinion that 'the majority of the many plants common to the Himalayas and Java, migrated over continuous intervening land which has been broken up by geological causes, chiefly subsidence; just as the partial subsidence of Java itself would effect a further dismemberment of the area now continuously peopled with plants, and which would result in a cluster of islets having a vegetation in common. Extending this idea of submergence and emergence of land, one island may at different epochs have been continuous with different continents from all of which it may have received immigrants.' They do not deny the active agency of wind and animals in aiding distribution and also of oceanic currents to a limited extent, but between some of the present-day isolated colonies the distances are so great that the above seems to be the more plausible, and certainly the more wholesale, explanation.

Meinertzhagen (9) is also of the opinion that the present-day patchy distribution of the genus *Rhododendron* in such widely separated areas as the Himālayās, the hills of Ceylon and Malabār, the Malay Archipelago and Queensland can be satisfactorily accounted for only on the assumption that at one time its distribution was more or less continuous (possibly in distributional waves) to the limits of its present range. The same explanation would

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also hold in the case of the genus *Rubus* which, as I have suggested above is more or less coincident in its range with *Trochalopteron*.

As regards animals such as the Nilgiri Tahr and Marten among Mammals and the genera *Garrulax* and *Trochalopteron* among Birds, and indeed all the peculiar rain-forest forms above named, as well as the forms common to Africa, Madagascar, India, Malay Peninsula and Archipelago and elsewhere, the origin of their present-day colonies seems most satisfactorily explainable only by the theory (based on good geological and palaeontological evidence) of their being relic colonies of a former extensive and continuous distribution, the intervening population having disappeared owing to adverse competition either climatic or physical.

Summary.

1. Geological action has produced similar physical features in the widely separated areas under reference.

2. Owing to the similarity of their relief and geographical position relative to the strike of the South-West Monsoon currents, they are all areas of heavy rainfall and great humidity.

3. The homogeneous nature of the flora which—through subsidiary ramifications such as the attendant insect-life and other symbiotic inter-connections—must be considered the final determining factor, accounts for the homogeneous nature of the avifauna resident therein.

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Itinerary and Ecological Data of Areas Worked.

In the following pages I have been at special pains to record as accurately as possible the topography and ecological features of

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the areas worked by the Surveys, the rough data for which were actually obtained on the spot. This necessitated the collection of a large number of characteristic plant specimens and those that appeared in any way to influence or be influenced by the local bird-life, for the identification of which material I am indebted to Mr. C. McCann of the Bombay Natural History Society and Mr. K. Biswas of the Calcutta Herbarium.

With the universal recognition of geographical variations and their crystallization into local races or sub-species, coupled with the refreshing tendency in recent years towards breadth in the handling of biological problems, it is obvious that greater precision than heretofore in statements concerning the distribution of animal-life has not only become increasingly desirable but a positive necessity if the utmost scientific value is to be extracted from records and specimens. When working such a physically complex region as Travancore-Cochin it becomes evident how important is the study of ecology, i.e., of the connection between organisms and their animate and inanimate environment, and how misleading the use of loose generalisations in describing the distribution of animal forms. To one unacquainted with the divers aspects of relief and vegetation obtaining within such a comparatively small tract of country the occurrence, apparently side by side, of two such forms as *Dichoceros bicornis*—essentially a bird of tropical and sub-tropical evergreen forests—and of, say, *Eremopterix grisea*—usually associated with barren wastes—would seem anomalous. Instances of this kind of incongruity are for ever obtruding themselves on the critical student throughout the *New Fauna* volumes. Loose statements like 'the whole of Burma', 'Assam', 'Ceylon' or 'Travancore' are there common, and when applied to such specialised and narrowly restricted forms as the above, without any relative ecological data, they only mean confusion.

Careful and rational field-work on species in their natural environment is the *sine qua non* for the study of Bird Ecology, which is clearly a subject that can best be taken up by enthusiasts resident in the country. It is a virgin field and every student with an observant eye and an enquiring mind can make some contribution to the study, howsoever small and seemingly insignificant. A great many biological puzzles await solution by intensive ecological study and it is a line of research that may now be recommended to workers in India as being of far greater importance and potentialities than the mere collection and labelling of skins.

Barring restricted areas and particular groups which still require careful collecting and working out, we can now claim to have a sufficiency of dead ornithological material from India in the great museums of the world to satisfy the needs of even an exacting taxonomist. Most bird-lovers in this country possess neither the inclination, training nor facilities for making any substantial additions to our knowledge of systematics. Speaking generally, therefore, Indian systematic ornithology is best left in the hands of the specialist or museum worker who has the neces-

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A Panorama of the Cardamom Hills, Santhanpāra.

A Cardamom Plantation (Santhanpāra)
A Favourite Bird Haunt.

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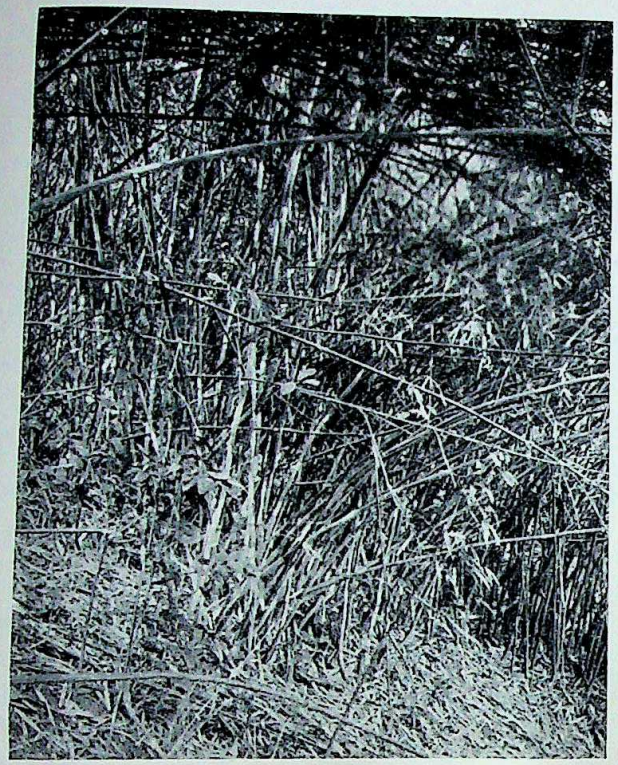
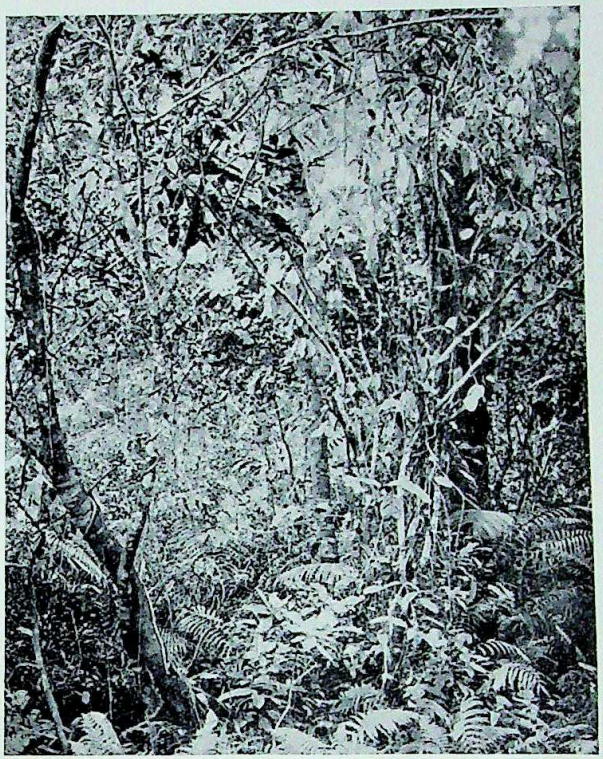


Photos

"Eeta" (*Ochlandra travancorica*), facies of the jungle at Thattākad.



Author

Typical moist evergreen forest, Thattākād, where the only 2 specimens of *Batrachostomus moniliger* were obtained.

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sary material and facilities at his command. This is not by way of disparagement to workers in India; far from it. But the point must be stressed that workers in India are in a position to contribute to the solution of the many problems in a different, but by no means less important, way, i.e., by intensive inductive and deductive field observation of a rational kind, an investigation denied to the musem worker abroad. My plea therefore is merely for division of labour.

I hope to be able in a subsequent paper to make some suggestions which may help to obviate the existing generalisations in distributional terminology, so often misleading. The first desideratum is to classify and define different biotopes and facies such as Evergreen Forest, Sandy Desert, etc. on the strength of easily recognisable characters. Isozoic tracts or units inhabited by similar forms of life (such as are dealt with in this paper) might be appropriately named after their most salient features, vegetable or animal, and the distribution of animal forms expressed in terms of these.

In the course of this paper I have frequently made use of the terms *Biotope* and *Facies* in describing the habitat of birds. The latter differs from the former in the same way as race from species i.e. a Biotope may be split up into several Facies. Just as Species rise into Genera, and these in turn into Families, Suborders and Orders, so can Biotopes be arranged according to their affinities into higher groups and these again into still higher units. Some excellent suggestions are given by Hesse in his *Tiergeographie* (5).

Travancore State.

1. **Māraiyūr,** alt. ca. 3,500′—3-15 January, 1933.

In North Travancore, ca. 10°17′ N. × 77°10′ E., 11 miles south of the frontier station of Chinnār.

A valley among high hills of the Ānnemalāi range, which here rise to over 8,000 ft. There is extensive paddy cultivation throughout the length and breadth of this valley, which, on account of its hilly nature, has to be terraced into small fields of irregular shape, coincident with the contours of the slopes. Paddy is also cultivated higher up in the hills in terraced fields. One of such hillmen's settlements is Kūdakkādū, about 4 miles from Marāiyūr and at about 4,000 ft. elevation.

Intersecting these terraced fields are numerous hill nullahs of which the perennial ones supply the irrigation for them. The sides of these nullahs, especially higher up, are heavily overgrown with bushes and scrub of every description in which the prickly wild 'Raspberry' (*Rubus ellipticus* Smith) predominates, often rendering the growth impenetrable. The larger perennial nullahs have boulder-strewn beds and are bordered by strips of varying width of evergreen jungle.

Immediately surrounding the little village and camp shed, the country is deciduous scrub-and-bush where Lantana predominates. *Zizyphus oenoplia* also occurs sporadically. It was only in this little patch that *Pycnonotus luteolus* was met. In the vicinity are a number of dense Sandalwood Reserves planted by the Forest Department, this locality being especially suited to the growth of the plant.

Many of the surrounding hills have their higher slopes and tops of bare sheet rock with sparse coarse grass and shrubs springing from hollows and crevices where sufficient soil has accumulated to afford roothold. The hills up to about 4,000 ft. are clothed in mixed evergreen and deciduous jungle, alternating with open patches of coarse grass and dwarf *Phoenix* (*farinifera* ?)

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clumps. Lower down, on the slopes rising from the valley, Bamboo (*Dendrocalamus strictus*) with culms up to 3 in. in diameter and 30-40 ft. high, preponderates.

Above 4,000 ft. the bare slopes alternate with patches of evergreen sholas growing in damp ravines. These sholas are a characteristic feature of the landscape here as they are elsewhere in the Nilgiris and other South Indian Hills. They are composed mostly of evergreen trees of comparatively small size with rounded crowns and have a rich undergrowth in which species of *Strobilanthes* are well represented. Among the more characteristic trees are: *Michelia nilagirica, Ternstroemia japonica, Eurya japonica, Gordonia obtusa*, species of *Eugenia, Ilex, Meliosma, Euonymus, Symplocos* and various Lauraceae.

The temperature ranges from 56°-78° F. The rainfall averages 58·5 inches per annum and the locality, except in winter, is notoriously malarious.

2. **Mūnnar,** alt. ca. 5,000′—16-20 January, 1933.
(10°5′ N. × 77°4′ E.; ca. 15 miles S.S.W. of Marāiyūr.)

The centre of the tea-planting district in the Kanan Dēvan Hills (the northernmost section of the High Range) within the concession of the Kanan Dēvan Hills Produce Co. Ltd. This concession, about 1,37,000 acres in extent, has been in existence for about 60 years with the result that the hilly country for miles around has been cleared of all forest and planted over with tea, with *Grevillea robusta* and *Erythrina lithosperma* for shade. Large patches have also been planted with a species of Eucalyptus for fuel. With the absence of forest, there is a marked paucity of bird-life, and such as there is, is mostly confined to the scrub jungle in ravines and bordering the streams that run through the tea estates. These scrub patches consist for a great part of *Rubus ellipticus* Smith and Eeta Bamboo (*Ochlandra travancorica*). Two of the commonest shrubs in these associations are: *Trema orientalis* Blume, generally by streams and nullahs, with berries largely sought after by *Turdus, Carpodacus,* etc., and *Maesa perrottetiana* D.C. whose white berries are a favourite of *Trochalopteron, Carpodacus* and other birds. Average annual rainfall 153″.

3. **Santhanpāra,** alt. ca. 3,500′—22-31 January, 1933.
(ca. 15 miles S.S.E. of Mūnnār; 9°58′ N. × 77°13′ E.)

In the Cardamom Hills section of the High Range, about 6 miles distant from the ridge which marks the boundary between Travancore State and Madūra District of Madras. The country here is very hilly. The higher slopes and tops of many of the hills are devoid of forest, being clothed with coarse grass, the bareness being here and there relieved by patches of evergreen shola, mostly in the ravines. The hills to the N.-E. of the camp-shed are heavily covered with evergreen forest mostly thinned for cardamom cultivation which is here practised on an extensive scale. This is ideal bird country; one can walk long under the canopy of the lofty trees for miles, and the visibility is as good as in a park. The forests contain gigantic trees often over 100 ft. high and of enormous girth, many of them being buttressed. *Cullenia excelsa* with its spiny fruit resembling miniature Durian (*Durio zibethinus*) is one of the commonest species, *Mesua ferrea* being another. Gigantic dammer trees (*Canarium strictum*), with outwardly flaking bark, are frequent. Some of the other common species are: *Vateria indica, Calophyllum tomentosum, Hopea parviflora* and *H. Wightiana, Dysoxylum malabaricum, Acrocarpus fraxinifolius, Artocarpus hirsuta* and *Hydnocarpus Wightiana*. Many species of *Ficus* occur, affording sustenance to numerous birds. Bamboos, except *Ochlandra travancorica*, are practically absent. The latter is found growing in dense thickets on the banks of streams, but more plentifully higher up on the hills about the upper limit of cardamom cultivation (4,500 ft. or so). In scrub patches on the outskirts of evergreen jungle *Rubus ellipticus* is plentiful. In association with this are usually found *Triumfetta rhomboidea* Jacq. and *T. pilosa* Roth., *Solanum verbascifolium* L., and *Polygonum chinense* L. whose slaty black berries are largely eaten by Bulbuls and other birds. Bracken also grows freely among the scrub. The lower hill-slopes are covered with dense clumps of coarse elephant grass often over a man's height, sprinkled here and there by thin scraggy trees of *Grewia villosa* Willd. or *Phyllanthus emblica*. This facies is generally more or less bare of bird-life; only near

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the tops of the hillocks where the grass is often short (and now burnt) and interspersed with outcrops of sheet-rock, are there any pipits and larks, albeit scarce.

On a hill-top above cardamom cultivation, at ca. 5,000 ft. (Kallipāra) there is a small perennial tank in a hollow, about 100 yds. × 50 yds. called Noolamkūlam. The hill-tops round this place are covered with sparse evergreen forest with tall straight seedlings often over 7 ft. high, and an undergrowth of *Strobilanthes*. A good deal of Eeta Bamboo is also met with here in patches that are almost impenetrable. The trunks and branches of the forest trees are heavily covered and hung with moss. The only birds met with here were *Trochalopteron j. fairbanki*, *Acrocephalus dumetorum*, *Pellorcnum ruficeps granti* and *Sitta frontalis*.

Around the cardamom store-sheds and coolie-lines which are dotted about the forest, Bananas grow luxuriantly, their flowers being in regular attendance and most probably fertilised by *Arachnothera longirostris*.

The temperature ranged between 56° and 80° F. The average annual rainfall is 74·2″.

4. **Thattākād** (Thattā = plains, kād = forest), alt. ca. 200′—2-13 February, 1933.

(ca. 10°7′ N. × 76°41′ E.; on the left bank of the Periyār River.)

The forest which is principally confined to the right bank of the river, consists in patches of both deciduous and tropical evergreen with frequently a mixture of the two. The commonest species in the evergreen are *Terminalia paniculata* and *T.* (*chebula* ?), *Calophyllum tomentosum*, *Artocarpus* and species of *Pterocarpus*, *Cedrella toona* (?) and *Mangifera indica*. Among these are often intermixed Teak, Ironwood (*Xylia xylocarpa*), *Dipterocarpus*, *Albizzia*, etc. The evergreen undergrowth consists of a good deal of rattan (*Calamus*) and many prickly species of which *Acacia concinna* DC and the 'Incha' (*Acacia intsia*) a sprawling and climbing species with recurved thorns, are perhaps the most plentiful and troublesome. They also occur abundantly in scrub growth on the outskirts of forest. Many of the trees in secondary jungle are thickly-draped and festooned with their tangles. A feature of the evergreen jungle is the fern-like creeper with longish drooping leaves, *Stenochlaena palustre* L. and the wild pepper vines, both of which climb up the tree-trunks to great heights. The prickly climber *Mezoneuron cucullatum* W. & A. var. *grandis* thickly drapes the trees in secondary evergreen patches here as at Santhanpāra. Its yellow flowers are regularly probed into by Sunbirds, Spider-hunters, White-eyes and Chloropses.

On the right bank of the river also, there is a series of plantations of the Forest Department: Teak, Rubber and *Bombax*. The first is about 6 years old, mostly devoid of undergrowth and poor in bird-life. The rubber is about 25 years old, but owing to default of the contractor the weeding has not been done for some years with the result that Lantana, 'Incha' and a host of other species have overrun the place in impenetrable denseness. This area is the best of the three as regards birds. The *Bombax* plantation (25 acres) is only a year old and little more than a forest clearing so far. When the trees are old enough to flower, this place will become a paradise for the bird-watcher. In the *Bombax* clearing may always be seen *Hirundo*, *Indicapus*, *Merops*, *Melittophagus*, *Coracias*, *Eurystomus* and *Dicrurus*, while in the Lantana and scrub separating the clearing from the forest are met *Acrocephalus dumetorum*, *Phragmaticola*, *Prinia inornata* and *Franklinia*.

In the Government Rubber Plantation and adjoining forest there is a great deal of *Erythrina lithosperma* now in flower (with foliage on), which are visited by innumerable species, especially by hundreds of Lorikeets all day long but chiefly in the mornings up to 11 o'clock or so. Among the other visitors the most regular are Parakeets, *Sturnia malabarica*, *Dicruridae*, *Dendrocitta vagabunda* and *D. leucogastra*, *Arachnothera* and *Leptocoma*.

In the evergreen forest there is a sprinkling of gigantic trees with enormous straight boles often 70-80 ft. to the first branch. The undergrowth consists of seedlings with sparse *Calamus* brakes, lianas, creepers and fallen brushwood. In places the ground is dank and almost marshy.

On the left bank of the river, upstream, and about ½ mile distant from the camp-shed, commences the Palamāttam Rubber Estate (about 900 acres)

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which stretches along the river almost up to Neriāmangalam. It is fairly well-weeded and is on the whole poor in bird-life except for woodpeckers which fly about among the tree-trunks. Beyond the rubber belt is paddy cultivation, flanked by fairly open deciduous jungle which in places degnerates into stony undulating grassland.

About four miles downstream, on the left bank of the river, open undulating and stony grassland is met, with sparse deciduous shrubs. The dry nullahs intersecting the undulations are heavily clothed in scrub. *Lantana, Triumfetta, Acacia incia* etc., intermixed with tall elephant-grass. It is the typical deciduous country of many places on the Deccan Plateau and here, for the first time in Travancore, were also met *Mirafra* and *Saxicoloides*, so common in the Deccan.

Along the banks of the Periyār River, and those of the many small streams that flow into it, are dense clumps of Eeta (*Ochlandra travancorica*) and they are likewise often lined with 'Omé' trees (*Trema orientalis*) whose berries are a great attraction to all frugivorous birds.

The river here for a considerable distance, runs in a succession of shallow rapids. All along there are numerous diminutive islets in its beds often merely a couple of smooth rounded moss-covered stones on which clumps of Cyperaceae grow. On the mud-banks in the middle and at the sides there also grows much *Phyllanthus Lawii* (?) or some similar sort of 'tamarisk'.

No water-birds were seen except kingfishers, *Ardeola grayi*, *Anhinga melanogaster* and *Motacilla madraspatensis* which were usually present in small numbers.

The country hereabouts is stiff with Wild Elephants and bird-collecting often provided unexpected thrills!

Thattākād principally gets the S.-W. Monsoon, but a few falls of the N.-E. Monsoon are also received. The average annual rainfall is about 141·5".

On 4 February, the following temperatures were recorded: 6-30 a.m., 70° F.; 4 p.m., 90° F.; 8 p.m., 80° F. The humidity is great.

5. **Kottāyam** alt. ca. 100'—13-20 February, 1933.
(ca. 9°35' N. × 76°31' E.)

A fairly large town and the district headquarters, surrounded by extensive cocoanut and paddy cultivation. Canals connect the town on the western side with the Vembanād Lake, a larger backwater lagoon. The water in this lake is brackish except for a couple of months during the monsoon when it is said to be potable. All around the margin of this lake are extensive cocoanut plantations and paddy cultivation. The paddy lands are below the level of the lake and the water has to be kept out by laboriously constructed dykes. A species of *Pandanus* is largely grown on these dykes or bunds its roots acting as reinforcement material and helping to hold the mud from being washed away. The paddy lands are left fallow every alternate year. The dyke is breached and the water allowed to flow in and completely submerge the land.

Ploughing in the submerged fields is done by means of buffaloes whose backs and snouts alone show as little ridges above the surface of the water while the ploughman walks behind them often immersed to his chest. Two crops are sown and gathered in quick succession between the end of the S.-W. Monsoon and its commencement next year.

The bunds or portions of them with the tall grass and *Pandanus* stand out like little islets, forming ideal haunts for *Acrocephalus stentoreus* and *Prinia inornata* and offering favourite nesting sites to *Ploceus manyar*. The backwater canals are lined with Cocoanut, *Pandanus*, *Thespesia populnea* and *Cerbera odollam* trees, the last with white flowers and round green fruit of the size of tennis balls.

Beyond the paddy-lands and in among the cocoanut groves are little habitations and homesteads surrounded by trees of Areca-nut, Jack-fruit, Cashew, Mango and Banana. In this facies are to be found such birds as *Leucocirca*, *Tchitrea*, *Molpastes*, Mynas, Parakeets, Lorikeets, Striated Munias and the like.

The places visited in Vembanād Lake were: Aleppey, Kūmārāgām and Munro Island (Padīramanal). The first is a sea-port and a busy trade centre. Kūmārāgām is one vast expanse of cocoanuts and paddy with huts here and there surrounded by banana and jack. It was here that the first lot of *Psitta-*

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cula krameri in Travancore was met. Munro Island is a flat oval piece of land, 8-10 miles west of Kottāyam, under paddy and cocoanut. It is cut up by irrigation channels or trenches for watering the young cocoanuts, whose banks are in places covered with *Pandanus* tangles, as are also the edges of the island itself for the most part. In the paddy-fields here, snipe are plentiful.

Vembanād Lake has crystal clear water through which the sandy bottom (8-10 ft. or more) below is clearly visible. It is on the whole a disappointing place from the ornithological point of view as it presents an open expanse of water for many miles in every direction with no sandbanks or reed-covered islets. Except for some gulls and terns and one or two gigantic flocks (10,000 or more!) of teals—chiefly Garganey, and a few Whistlers—little else was noted.

On the eastern (the land) side of Kottāyam there are again extensive groves of cocoanut, which a few miles inland gradually give place to pepper cultivation. This in turn changes into rubber plantations interspersed, as at Urūmbikera, with reserved forest areas, mostly deciduous but often intermingled with evergreen species. The nullahs here are densely lined and overgrown with *Sarcocephalus missionis* trees. In the thickets much Lantana and *Acacia incia* with sprawling pliant branches and recurved thorns, occurs. The damper portions of the banks and dank hollows are thickly overgrown with a species of wild zingiberous plant with tall straight stems knotted like bamboos, the knots being much swollen. They are known in Malayalam as 'Channa'.

The rubber plantations extend all the way up to Mūndakāyam and the foot of the Peermade hills.

The temperature at Kottāyam was as follows: 6-30 a.m., 76-80° F.; highest during the day 94° F. The humidity is excessive. The annual rainfall is 124·6″ received principally during the S.-W. Monsoon.

While in the Travellers' Bungalow at Kottāyam, I had a visit from a local 'sportsman', a retired police constable, who having heard that I was collecting birds, called to book orders. The 'bag' he brought along as sample consisted of battered specimens as follows: 3 *Acridotheres tristis*, 2 *Halcyon smyrnensis*, 1 *Æthiopsar fuscus*, 1 *Oriolus kundoo*, 1 *O. xanthornus*, 2 *Thereiceryx viridis*, 1 *Chloropsis jerdoni*. The man boasted that he got, and could get, them in every month of the year—whether they were breeding or not—ostensibly for food. He said there were in that locality several other shikaris like himself who shot everything that came along provided it was large enough or in sufficient numbers to expend powder and shot on. This is a practice that the authorities must take immediate notice of and put a stop to.

6. **Peermade** alt. ca. 3,200′—20-26 February, 1933.

(ca. 9°34′ N. × 77°0′ E. About 40 miles due east of Kottāyam, in the High Range.)

Bare open hills covered with dense clumps of a tall coarse grass. The hill-tops are often rounded, but some have jagged, precipitous contours. The ravines and valleys of streams, both down the slopes as well as along the foot of the hills, are everywhere clothed in patches of evergreen forest. In these sholas lofty trees of *Cullenia excelsa* are common. *Calamus* is a feature of the undergrowth in such spots, which, throwing out their fine lash-like 'climbers' covered with recurved thorns make progress through the jungle painful and slow. In the damper places, the wild Zingiber (Malayalam: *Channa*) is abundant. The open grass hill-tops and slopes are punctuated by clumps of a dwarf *Phoenix*. Guava trees are plentiful for miles around the town, and the scrub in the drier places is composed principally of *Lantana*. In the environs of Peermade, especially to the north, are numerous tea plantations. Little patches of cardamom cultivation also occur. The Arūdāi stream (Arūdāi being the original name of Peermade) winds through the town, running through deep-cut ravines.

Rubus absent, so also *Trochalopteron*.

The temperature at 6-30 a.m. was about 70° F., the highest during the day being 78°. The average annual rainfall is about 200″.

7. **Kūmili**, alt. ca. 3,000 ft.—26 February-8 March, 1933.

(ca. 9°37′ N. × 77°10′ E. About 14 miles east of Peermade.)

The country to the south and in the environs of Periyār Lake consists largely of deciduous forest which is interlarded here and there with patches

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of evergreen. The former is comprised principally of Teak, *Phyllanthus emblica*, *Terminalia paniculata* (very common), *Careya arborea* and sparse bushes of a species of *Grewia* and of *Helicteres isora*. The country is undulating with many hills and ravines and much flat grassland in between. Everywhere the undergrowth in the deciduous forest consists of dense clumps of tall elephant-grass often over 7 ft. high with, at intervals, dwarf clumps of a wild *Phoenix* and straggly sprawling bushes of *Zizyphus rugosa*.

Mortality among birds must be heavy when these large tracts of grassland are burnt, as at this season (March), both in the species which roost in the grass clumps and bushes as well as in those which nest in tree-holes at moderate heights, such as *Parus* etc. and of course in all ground-birds like Bush-and Bustard-Quails. These fires must be especially destructive during night when fanned by a strong breeze, and when escape for the birds is impossible.

Gigantic *Bombax malabaricum* and *Calophyllum tomentosum* trees are common in the evergreen patches where they tower above the surrounding vegetation. The former are frequently 6 ft. or more in diameter at 10 ft. height, and practically uniform in girth up to the first branch at 50-70 ft.

The Periyār Lake has a maximum level of 2,861 ft. above mean sea-level. It is formed by the damming up of the Periyār River near its source. The dense evergreen forest that once covered the ravines and valleys has become submerged and at present only the gaunt trunks of the forest giants stand out of the water. This lake supplies irrigation to the rice-fields of the plains of Madura District beyond the eastern confines of Travancore. Owing to the perennial water supply and the cover afforded by the jungles of the catchment area, the environs of the lake are full of Bison, Elephants and other forms of wild life, and have lately been selected by the Travancore Government for a Game Sanctuary.

The lake itself is an absolute washout as far as birds are concerned. With the exception of a few *Anhinga*, *Halcyon smyrnensis* and *Haliastur indus* near the head-works, there is nothing, the water being mostly deep with steep shelving banks.

The country north of the Periyār Lake, towards Wundāmet or Vandāmettu is all open, bare grassy hills with an occasional sprinkling of light scraggy deciduous species of trees such as *Phyllanthus emblica*, *Buchanania latifolia* and *Dalbergia latifolia* with some Teak here and there. In the ravines on the hillsides or in between them, are small patches of evergreen shola, sometimes only half an acre or less in extent, with luxuriant undergrowth of the wild zingiberous plant (*Channa*) and rattan (*Calamus*). In these isolated patches were met pairs or a few each of *Pomatorhinus*, *Pellorneum*, *Rhopocichla*, *Culicicapa*, *Hypothymis*, *Iole*, *Irena* and *Ducula cuprea*.

The bottom valleys among the grass hills (at present all burnt out) are moist and often swampy, with dense growth of finer grass of a different species, tangled and spongy to the tread, and sometimes over 3 ft. high. In these patches *Schoenicola* was not uncommon though singly and scattered, also *Prinia socialis*. These marshy patches with their fresh green grass, and reeds at their margins, were the only features to relieve the monotony of the charred and dreary landscape. Average annual raifall 71·5".

8. **Camp Derāmalāi**, ca. 3,000'—9-13 March, 1933.
(In the Panthalam Hills, ca. 10 miles due south of Kūmili across the Periyār Lake.)

The country between the southern end of the Periyār Lake, i.e., from about the dam almost to Camp Derāmalāi, consists of a vast succession of open grass-topped hills interspersed with patches of evergreen shola in the moist protected ravines. Evergreen forest commences in the neighbourhood of Derāmalāi and the forest-clad hills and ridges (Panthalam) succeed one another almost unbroken southwards down to Kōni in Central Travancore.

Enormous trees of *Canarium strictum*, *Calophyllum tomentosum*, *Cullenia excelsa* and *Vateria indica* are prominent, while the many species of lofty *Ficus* (now in fruit) attract numerous birds everywhere. The dammer trees (*C. strictum*) with their peculiar outwardly flaking bark are suggestively known in Malayālam by a name which means 'that which a lizard cannot climb'.

To the south-west of Derāmalāi the forest extends to Rāni over very hilly country which forms the catchment area of the Pambāiyār River. The tops

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of many of the evergreen hills in this direction present open, dome-shaped grass-covered patches with outcrops of sheet rock.

Camp Derāmalāi is on the northern fringe of the Panthalam Hills. Beyond Downton Estate (Cardamoms)—where thanks to the hospitality of the genial proprietor Mr. J. R. Vincent and his sister, we are encamped—to southward there is practically no human habitation in the forest.

Average annual rainfall ca. 71·5″.

9. **Rājampāra,** ca. 1,350′—15-21 March, 1933.

(ca. 9°22′ N. × 76°54′ E. About 20 miles W.S.W. of Derāmalāi on the western boundary of the Panthalam Hills.)

Hilly country, ridge upon ridge, mostly deciduous forest or open slopes under tall coarse grass, with patches of evergreen here and there in the ravines. In the deciduous forest, gigantic trees often over 120 ft. high and 10 ft. girth, of *Calophyllum tomentosum* are common, at present leafless and heavily laden with fruit which is largely eaten by birds such as *Thereiceryx*, *Dendrophasa*, *Ducula* and many others. Other common species in this facies are *Xylia xylocarpa*, *Dalbergia latifolia*, *Careya arborea*, *Gmelina arborea*, *Terminalia paniculata* and *Bombax malabaricum*. Among the undergrowth in deciduous country, by far the most abundant species is *Lantana camara*, with *Acacia intsia* a close second. Sprawling trees and bushes of *Zizyphus rugosa* are also common. Thickly bordering the ravines and anywhere where the hillsides retain any moisture, i.e., where there is any depth of soil (for the bed-rock is often denuded and exposed) grows in great profusion the wild zingiberous plant known as 'channa' already alluded to. Evidences of recent abundance of bamboo are noticeable here and there, especially about ravines and nullahs, in the shape of decaying root-clumps of those that died after flowering, a couple of years ago. Here and there also are common, usually singly, Cycad palms (*Cycas circinalis*) now mostly leafless with fruit, or sprouting their fern-like leaves. Also common here is a species like the Asparagus fern.

The evergreen patches contain the usual species, *Calamus* brakes being somewhat more prominent among the undergrowth.

Rubber is largely grown in this area, one estate of the Malayalam Plantations, Ltd. alone (Lahāi) having a planted acreage of 2,300. The locality at this season is subject to sudden and terrific cloudbursts of short duration, but heavy precipitation. On two successive evenings rain fell for about an hour measuring over 2″ each time.

The highest temperature recorded was 90-92° F.; the lowest 70-72° F.

The annual rainfall averages 139·4″, by far the greater part being received during the S.-W. Monsoon.

10. **Tenmalāi,** alt. ca. 500′—22-28 March, 1933.

(ca. 8°58′ N. × 76°4′ E. On the railway line near Ariānkavu Pass in Central Travancore.)

Hilly foothills country with mixed deciduous and evergreen jungle, more of the latter, the facies being similar to that at Thattākād. Teak, *Hopea parviflora* and *Bombax malabaricum* are plentiful, and there is much *Calamus* in the evergreens.

Many of the hillsides present precipitous scarps of rock, and outcrops of huge boulders occur here and there. The hills in the neighbourhood of Tenmalāi rise to about 2,000 ft. It was only at this camp that *Lyncornis* was met with, and a whistling owl (identity problematical) heard for the first time in Travancore.

The temperature ranged between 80° and 96° F. The average rainfall is about 115·2″ annually.

11. **Trivandrum,** ca. Sea-level; 29 March-6 April and 16 July-15 August, 1933.

(ca. 8°30′ N. × 76°57′ E. Capital of Travancore State.)

Low coastal terrain, more or less similar to that about the Konkan coast near Bombay. Rice cultivation and cocoanuts plentiful; also Palmyra palms (*Borassus flabelliformis*). Other familiar features of the vegetation are *Thespesia populnea* and *Calophyllum inophyllum*. Paddy crops now (April) standing in fields bordering tanks, and Weaver Birds (*Ploceus philippinus*) busy nesting.

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Mr. N. G. Pillai has furnished the following information regarding the localities in Trivandrum Taluk where he collected between 15 July-15 August.

(a) *Trivandrum Beach*: 16-7-33, 21-7-33, 1-8-33, 12-8-33.

'There are two main roads diverging from the Beach and entering the town, one at the northern end, the other at the southern. On either side of these roads are planted a good many Casuarina trees. The roads traverse a long tract of sandy waste, on the extreme west of which is a long line of houses, mostly fishermen's huts, and cocoanut plantations. During the rainy season most of this sandy tract is under water, leaving small islets here and there. On these can be seen plovers, terns, paddy-birds etc. Among the Casuarinas and neighbouring palms, the Swallow-shrike, Roller, Bee-eater, Kingfisher, Magpie, Robin, etc., are frequently met with.'

(b) *Pattom*: 17-7-33, 22-7-33.

'It is about 3 miles away from the heart of the town (Trivandrum) with an elevation of ca. 100 ft. Small hillocks covered with laterite pebbles and bearing tapioca cultivation are quite common here. In between the hillocks are paddy-fields. These are in blocks separated by bunds, each block being cultivated separately. In one whole patch of paddy with different plots, some will be nearing harvest, some just ploughed, while yet others will bear half-grown plants.'

(c) *Pūlayanārkotta*: 18-7-33, 6-8-33, 11-8-33.

'This is a small hill, ca. 200 ft., overlooking the Veli Lake, about 5 miles from Trivandrum. The soil is mainly laterite, in some places chalky and covered with pebbles. The hill is a Casuarina reserve. There is a dense undergrowth of *Ixora, Acacia* and other thorny plants. The common birds of this place are *Otocompsa, Molpastes, Glaucidium, Dendrocitta, Acridotheres, Leiopicus, Micropternus, Oriolus, Dendrophasa,* etc.'

(d) *Thirūmalāi*: 20-7-33, 24-7-33, 25-7-33, 30-7-33, 6-8-33.

'This is another small hill about 5 miles east of Trivandrum, the highest point of which is about 200 ft. It is studded with granite boulders of various sizes and shapes. The south-eastern side of the hill is covered with lemon grass (*Andropogon*). Towards evening on 30 July, I saw at this place about a hundred bulbuls (*Otocompsa*) flying about here and there before retiring to roost.'

(e) *Kuttani*: 26-7-33, 29-7-33, 10-8-33.

'This is a piece of hummocky country with small hills varying from 100-200 ft. Most of these bear tapioca, plantain and cocoanut trees, etc. leaving patches of evergreen forest here and there. One such is the Serpent Grove alluded to in Ferguson's paper, about half an acre in extent, adjoining a paddy-field. Huge trees like *Ficus,* and Talipot palms (*Caryota urens*) are seen here. The dense undergrowth of canes, screwpine and a host of climbers makes the places well-nigh impenetrable. It was here that I came across *Rhopocichla*. From a similar patch about a mile from here I got *Melittophagus*.'

(f) *Mārūthānkūzhi*: 27-7-33, 28-7-33, 31-7-33, 2-8-33, 15-8-33.

'About 3 miles east of Trivandrum. There is a small river—the Killiār —flowing past this place. A dam is constructed across this river and the Kochār takes water from this river to a big tank in the Fort. The Kochār flows past the foot of a hill covered with cultivation.

(g) *Veli*: 30-7-33, 13-8-33.

'There is a small lagoon here which communicates with the sea during the Monsoon. It is principally sandy country with stunted Cashewnut, *Calophyllum inophyllum* and other trees. Cocoanut and Palmyra palms are also very abundant. About a mile east of this place and on one side of the lagoon is a small grass-covered hill about 100 ft. high, studded with granite boulders.'

(h) *Akkūlam*: 31-7-33.

'This is a bit of hilly tract about 3 miles north-west of the town. Hillocks covered with stunted *Ixora* are a feature of the place. Lower down the slopes we get tapioca cultivation followed by trees like Tamarind, *Artocarpus* and *Ficus,* and still lower down, by paddy fields. The ground is covered with pebbles of laterite. Larks and Pipits are very common here. Towards the end of April I had come across a number of Yellow-wattled Lapwings here, all of which have now disappeared.'

(i) *Golf Links*: 2-8-33, 7-8-33, 14-8-33.

'This is a slightly elevated plateau (about 150 ft.) about 3 miles from

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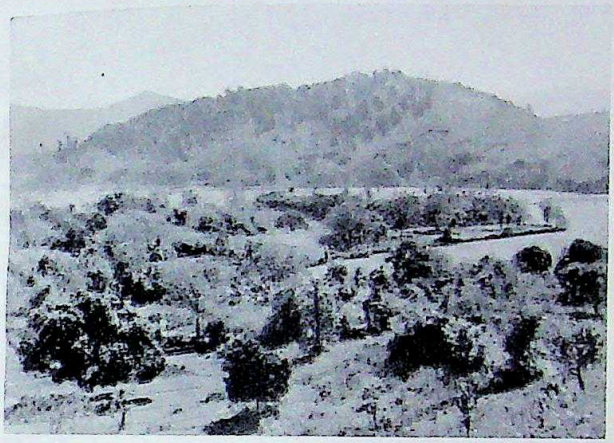

Typical country at Wadakkāncheri showing paddy cultivation in flat "valleys."

Bamboo Forest, Kuriārkūtti, with Cochin Forest Tramline.

A Backwater Canal, Kottāyam.

Photos

Tall grass (*Andropogon*) country on verge of *shola*, Santhanpāra, with an unlooked-for thrill in the middle distance!

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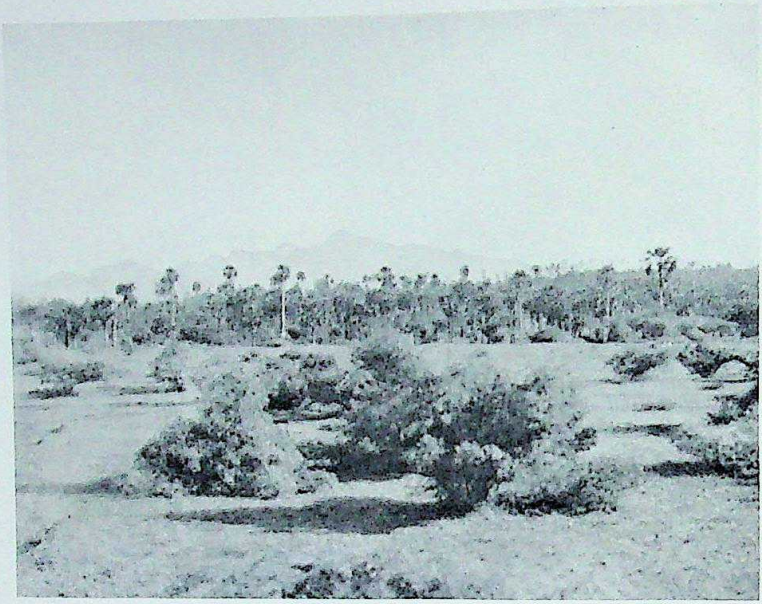

Typical country about Cape Comorin with the Ashāmbu Hills in the background.

Photos *Author*

Looking across the "Gap" at Aramboli.

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Trivandrum. It is an extensive green where Yellow-wattled Lapwings, Larks and Pipits are found in large numbers. There are trees like Mango, Tamarind, etc. planted all round the border and here the commoner birds Orioles, Woodshrikes, Chloropsis, Magpie Robins, etc. are met with.

(j) *Kovālam*: 3-8-33.

'About 8 miles south-west of Trivandrum, near the sea. The coast is formed of rocky cliffs forming a sort of belt between the low lying paddy-fields on one side and the sea on the other. Small hillocks covered with boulders may be seen slightly removed from the shore. The ground is covered with vegetation. I did not come across any sea birds here.'

(k) *Cattle Farm*: 4-8-33.

'Slightly wooded country about 8 miles north-east of the town. Similar in features to Pattom, Akkulam, etc.'

(l) *Nettayam*: 5-8-33, 9-8-33.

'About 8 miles east of the town. Hilly country about 200 ft. alt., covered with cultivation. Farther to the east, about 12 miles from this place, the Karamanai River meets this chain of hills.'

(m) *Poojāppūra*: 5-8-33.

'ca. 120 ft. Country similar to Pattom. The Karamanai River flows past here. Slightly removed from the river is a large sheet of water, about 10 acres in extent. The Skua, included in my collection, was captured from this place.'

(n) *Mūkkūnnimalāi*: 8-8-33.

'This is the highest hill in Trivandrum (ca. 800 ft.). About 5 miles S.-E. of the town. It is an evergreen forest and the sides of the hill are covered with a thick undergrowth of shrubs and thorny creepers. Granite boulders of varying sizes and shapes cover the hillsides. I came across the Ruby-throated Bulbul here.'

The average annual rainfall at Trivandrum is 66·9″.

12. **Cape Comorin**, ca. Sea-level; 6-14 April, 1933.

(ca. 8°5′ N. × 77°34′ E. The extreme southern point of the Indian Peninsula.)

Plains country similar to that about Trivandrum, with paddy cultivation here and there. *Thespesia populnea*, *Calophyllum inophyllum*, Cashew (*Anacardium occidentale*) and the umbrella-shaped *Acacia planifrons* are amongst the most prominent trees. *Borassus* and Cocoanut palms are abundant. 'Milk-bush' and *Inga dulcis* are largely used for hedges, and Cactus of a peculiar species, *E. antiquorum* (?), is plentiful.

Tamarind and *Pithecolobium saman*, an introduced species, are both very common and the latter grows to large size. *Melia azadirachta* also occurs freely.

The soil is chiefly moorum. A few miles north of the Cape commence the Ashāmbū Hills, steep, ragged precipitous and pinnacled peaks and ridges, mostly bare and rocky, with stunted vegetation, greener and more luxuriant in the ravines.

The temperature and humidity are about the same as at Trivandrum though the rainfall is considerably less, the average being about 40″ per annum.

13. **Arūmboli**, alt. ca. 250′—15-22 April, 1933.

(ca. 8°15′ N. × 77°15′ E. In a gap or pass through the Ashāmbu Range, through which runs the highway from Nāgercoil in South Travancore to Tinnevelly in Madras Presidency.)

The gap at its narrowest is about 2 miles wide. The hills on the northern and southern side of it are rocky, jagged and often precipitous with ragged pinnacles and deep clefts. The lower slopes are covered with sparse stunted vegetation of which the principal species are: *Dodonoea viscosa*, *Euphorbia neriifolia* and *E. antiquorum*, *Opuntia Dillenii* and very sprawling and spreading bushes (usually up to about 2 ft. high) of a small leaved thorny *Randia* (?) and of *Acacia intsia*. At the foot of the hills and in the 'Gap' there is cultivation bordered by scrub jungle consisting of *Melia*, Babool, etc. with Borassus palms sprinkled freely, especially along the bunds separating the fields. *Acacia planifrons* lends tone to the botanical features. Dense bushes of *Lonicera* sp. occur among the scrub of which *Phyllanthus reticulatus* and *Salvadora persica*

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(now in fruit and attracting many birds) are also common components. The rainfall averages 35.3″ per annum.

14. **Balamore Estate,** alt. ca. 2,000′—23-28 April, 1933.
(ca. 8°27′ N. × 77°23′ E. In the Ashāmbū Hills.)

Evergreen forest interspersed with coarse grassland on many of the hilltops and slopes. On these are scattered moderate-sized trees of *Careya arborea*, *Calophyllum Wightianum* and sprawling sparse bushes of *Zizyphus rugosa*. The surrounding hills, which rise to 6,000 ft. are more precipitous and rocky with jagged peaks and contours than in North Travancore. In the evergreens there is a dense and luxuriant undergrowth of rattan (*Calamus*.) The hills all over this locality bear traces of abandoned tea and coffee estates, the soil having proved too poor for them. The areas once cleared for these, are now overgrown with coarse grass or more commonly with Lantana scrub, the thickness of which must be seen to be believed. About 4 miles to the north as the crow flies, and at an elevation of about 4,000 ft., is Mūthūkūzhi Palace, formerly used by the Maharajas as a hot weather resort. After about 3,000 ft., bracken begins to increase. It is extremely abundant higher up where also appears (between 3,500 and 4,000 ft.) *Rubus ellipticus*. Patches at this elevation are densely under Eeta (*Ochlandra travancorica*) and the facies dominated by these three species seems to be the most suitable for *Trochalopteron*, which came into evidence as soon as about 4,000 ft. was reached.

About 4 miles west of Balamore is the Kodāyār Lake, formed like the Periyār, by damming up the Kodāyār River, and used for irrigation purposes. At the elevation of the Travellers' Bungalow, 2,000 ft. (situated on the edge of the Tea Estate), Mango and Jack trees appear to thrive.

Rainfall average: 81·5″ per annum.

Cochin State.

15. **Kūriārkūtti,** alt. ca. 1,600′—12-22 November, 1933.
(ca. 10°25′ N. × 76°43′ E. In Kodasseri State Forest.)

Forest mixed deciduous and evergreen, more of the latter on the higher surrounding hills, especially in ravines etc. On the hillsides, where steep and precipitous, tall coarse grass grows on a denuded rocky soil with outcrops of sheet rock. In such places *Cochlospermum gossypium* grows. The forest round Kūriārkūtti is now full of *Bambusa arundinacea*. Forty years ago there was no bamboo available in this part, so that the Forest Working Plans Officer reporting on the area mentioned that owing to want of bamboos for rafts, the logs could not be floated down the Parambikolam River and recommended the building of the existing Forest Tramway. The timber extraction has been carried on in a very destructive manner and in place of the denuded forest, bamboo has made its appearance in great density and profusion. Some of the commoner trees in the forest are *Calophyllum* ('Poon'), *Hopea parviflora*, *Xylia xylocarpa*, *Lagerstroemia parviflora* ('Venteak'). They grow to magnificent size and quality. Here and there are also sprinkled enormous trees of *Bombax malabaricum*.

Creepers of *Butea superba* are common in the deciduous-and-bamboo-forest, festooning the trees and twining up their stems.

Helicteres isora is a common component of the undergrowth. It is now in flower and invariably attracts Chloropsis and Sunbirds.

The bottom valleys among the hillocks in the bamboo forest are often open swampy spaces of varying size, covered with rank grass and other vegetation and much frequented by Elephants, Gaur and other game.

Men and boys of the aboriginal Kādar tribe scour the country all day long with bows and pellets killing everything they can. I saw *Pycnonotus gularis* and *Ægithina tiphia* killed in this way. They also wage unceasing war upon the nests of the Great Hornbill whose young are esteemed a great delicacy.

The average rainfall is 125-130″ annually.

16. **Wadakkāncheri,** alt. ca. 400′—23 November-2 December, 1933.
(ca. 10°40′ N. × 76°15′ E.)

Hummocky country, soil mostly laterite. The little hillocks are usually denuded of soil and littered with loose stones. They are covered with deciduous forest but in the damp ravines evergreen species occur. *Xylia* and *Calophyllum*

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saplings are common while the undergrowth is mainly of *Helicteres isora*. Lower down bordering the flats or bottom valleys (which are fertile owing to soil washed down from the hillsides, and in which paddy is extensively grown —2 crops a year) are dense thickets of Lantana.

Teak and *Dalbergia* are fairly plentiful in patches among the deciduous secondary jungle on the hillocks. On the sides of the hummocks, wherever the soil permits, are terraced fields of Gram and tapioca (*Manioc*).

Phyllanthus reticulatus grows commonly among the hedges, and its berries are largely eaten by Bulbuls, Orioles and other birds. Around the homesteads Cashew, Jack and Cocoanuts and Plantains are grown.

The localised bird associations or mixed hunting parties commonly met in this locality, at the edge of forest clearings, consisted chiefly of: *Dendrocitta vagabunda, Parus major, Graucalus macei, Tephrodornis sylvicola, Pericrocotus flammeus, Chaptia aenea* (very common), *Dissemurus paradiseus* and *Oriolus kundoo*. They invariably had *Turdoides* or some other ground rummaging species, and woodpeckers for their nucleus.

Loranthus longiflorus largely parasitizes *Dalbergia* and Cashew trees in this locality. It was now in flower and attended by the usual visitors, Sunbirds and Flowerpeckers.

17. **Nemmāra,** alt. ca. 300′—3-11 December, 1933.
(ca. 10°35′ N. × 76°37′ E. On the southern edge of the Pālghāt Gap.)

The Nelliampathy Hills commence here. Among the low rocky hillocks or foothills as they may be called, Nim, Tamarind and *Terminalia paniculata* seedlings are common. Lantana and sparse scraggy grass grows everywhere from accumulations of the soil in fissures and hollows among the rocks. The lower hills are covered with Teak, *Boswellia serrata, Xylia, Dalbergia* and other deciduous species, the undergrowth being composed for the most part of *Helicteres isora* and *Acacia intsia*. The teak trees in this locality are heavily parasitized by *Loranthus longiflorus*, the Flowerpecker *Dicaeum erythrorhynchos* being noted as the chief, if not sole, mischief maker.

Sparse grass-covered or bare hillocks of sheet-rock are commonly interspersed among the wooded ones. In the valleys or flats among the hills, paddy grows luxuriantly and there are also many natural tanks formed in the hollows which supply the irrigation to the paddy-fields.

18. **Pādagiri,** alt. ca. 3,000′—11-22 December, 1933.
(ca. 10°30′ N. × 76°41′ E. Nelliampathy Hills.)

This place is close to the Lily Downs mentioned by A. P. Kinloch in his 'Notes on the Avifauna of the Nelliampathy Hills' where also will be found some details of the topography. At 4,000 ft. and above, the hills have mostly bare tops with sheet-rock and straggly grass, which grows wherever sufficient soil has accumulated in the fissures and hollows to afford roothold. There are also steep scarps and precipices which form favourite haunts of the Nilgiri Tahr. On some of the gentler slopes there is the same tall coarse grass (*Andropogon*) as in the High Range of Travancore, similarly dotted with clumps of the dwarf *Phoenix*. Here and there in the ravines are evergreen sholas. The country and vegetation are on the whole very reminiscent of Santhanpāra in the Cardamom Hills of Travancore.

The Pālghāt Gap which is overlooked from the neighbouring hills is a stretch of flat country about 18 miles broad, dotted over with little hummocks or mounds of outcrop rock, but mostly under paddy with patches of light deciduous jungle and groves of *Borassus* palms.

At Tattamangalam (Chittūr) on the Pālghāt Gap, the average annual rainfall is 66″ while on the Nelliampathies over 150″ are usually registered. The mean annual rainfall at Ernakūlam is 102″; at Trichūr 132″.

19. **Karūpadanna,** alt. ca. Sea-level—25-31 December, 1933.
(ca. 10°16′ N. × 76°12′ E. On the backwaters.)

Typical vegetation and other features the same as at Kottāyam.

(To be continued).

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A HUNTING TRIP IN THE SUNDERBUNDS IN 1892.

BY

VICOMTE EDMOND DE PONCINS.

(*With four plates*).

On January 2nd, 1892, I left Calcutta for a trip in the Sunderbunds. The area was not very well known at that time, the only available map was the one by James Ellison (4 miles to 1 inch), published in 1783 and revised in 1891. On this map the maze of rivers of the delta was roughly indicated, but there were many blanks. Islands were shown by numbers, and rivers between them were often nameless. Some of them changed names on their way down to the Bay of Bengal. I shall refer to that map because I have no other and, if the reader wants fuller information, it will be easy to refer to more modern maps.

My plan was to try and see something of the more or less legendary rhinoceros which were supposed to dwell somewhere in this region and, at the same time, to get as much sport as I could with any available game. Tigers were said to be very numerous, deer and pigs swarming; so little known was that part of the world, that the unexpected might happen. It was then so out of the beaten track.

I hired from Kelso and Stewart, at Calcutta, a sort of house-boat with two small cabins as bed and dining rooms, and with it a crew of five Bengalis, another smaller boat with three men, as kitchen boat, and later on, added a small dinghy for shooting. Two so-called shikaris came with the last boat. I took my private servant and one or two of the 'nondescript' sort. They served as guides at places which they happened or pretended to know and were useful sometimes when sending for supplies or information, but otherwise often perfect nuisances. As I intended to stay a fairly long time I had to ship about two hundred and fifty gallons of sweet water. It was a difficult job as only earthern jars were available. Some broke when just filled up, others during the trip when I happened to be out. I always thought that the men, sick of the Sunderbunds after a time, did it on purpose to shorten our stay there for want of water. I had to send a boat, several times, to get fresh supplies as the life, if difficult, was intensely interesting.

The reputation of the Sunderbunds as a health resort stands very low indeed, and I should not dare to deny it. Nevertheless there were fifteen of us there for about a month and a half, and nobody ever got fever. The thermometer stood the whole time between seventy and ninety-five; the dampness was very trying. Inside my cabin, every morning, water dripped along the rifle barrels. I had to clean them every day. Frequently, there was a dense fog in the morning, the thermometer stood at eighty; while the dripping dew in the forest made a noise like heavy rain. During the rest of the day a dead stillness prevailed. More than once, when paddling up or down the rivers in a narrow dinghy, exposed to

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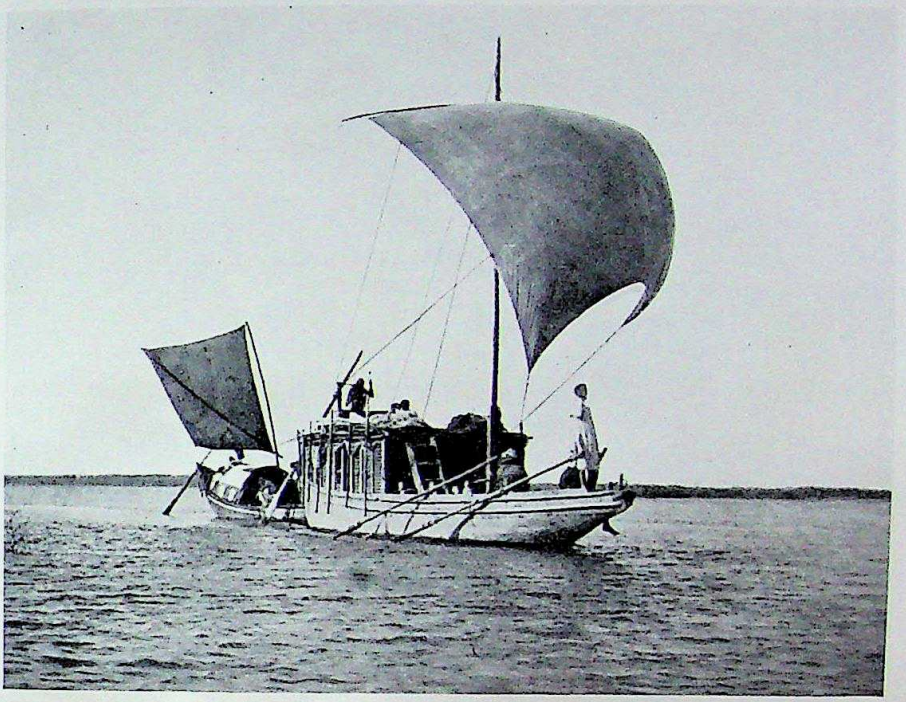
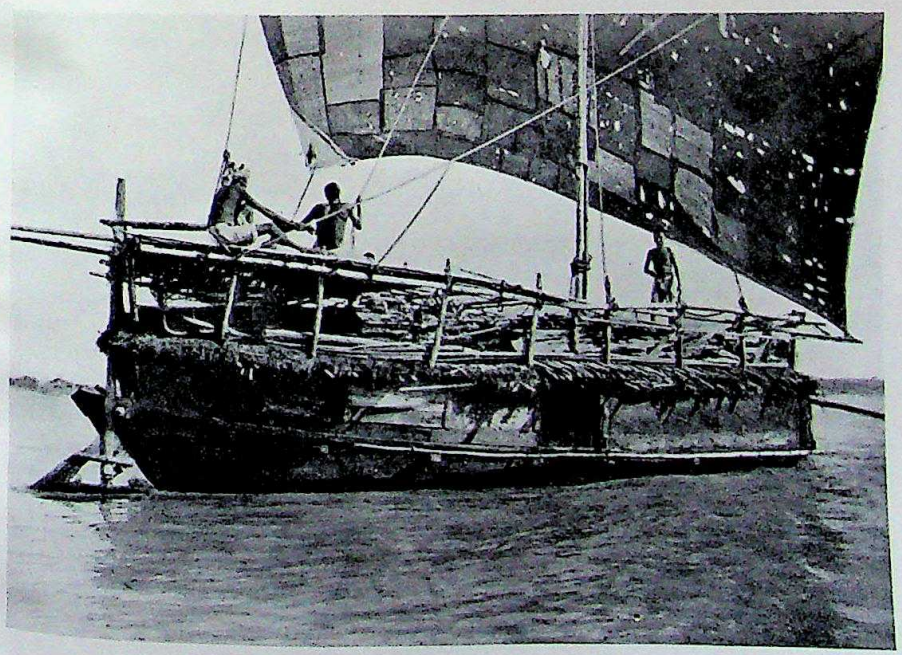


Sunderbunds, 1892. My boat under sail.



Sunderbunds, 1892. A native boat under sail carrying firewood to Calcutta—note the water line.

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Sunderbunds, 1892. Near Issuripore—Native Boats.

Sunderbunds, 1892. Near Issuripore—Native Boats.

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the full glare of the sun in a blinding haze of pervading damp, I thought that the limit of discomfort had been reached. But when one had to wait between two walls of glittering mud, with just enough water to float the boat, until the tide returned to resume the journey, I concluded that that paddling in the open was better.

The northern fringe of the Sunderbunds is more less inhabited and cultivated, but where the forest has the upper hand it is mud, trees and water. During my whole stay I never saw a clear space ten yards across. It was a dense forest of stunted trees with heavy foliage, or of enormous trees overgrown with creepers and thorny canes and of palms with immense leaves shooting straight out of the mud along the banks of small rivers. Everywhere roots sprung up forming a barrier which made walking very trying. Near the sea, the trees stood like gigantic spiders on roots four feet clear out of the mud. At spring tides, the whole of the forest was, for a while, inundated. I dare say there is not a square foot of dry soil in the great majority of the Sunderbunds. Landing meant sinking up to the knees in a sloping bank of sticky mud, the like of which I saw only at the mouth of the Guadalquivir. Once on the level under the forest, one had to plod along in deep mud. There was no grass, no undergrowth, some parts were covered by very dense tangle of thorny bushes, other parts were clearer under a canopy of foliage impervious to the sun, but so close were the trunks that the view was limited to not many yards.

The best and shortest way to reach the distant parts of the forest was by making use of the many small rivulets, when broad enough to take the dinghy. They were generally six feet broad and several feet deep, flowing between sheerly cut banks covered by big trees or lined by big screw palms. With the tide coming in, it was possible to proceed with it at a fairly rapid rate. The rising water raised the boat and brought one's head level with the top of the banks. Thus it was often possible to get a view under the vegetation for some distance. It was marvellous to inspect silently these deep forests without movement, noise, or exertion, the only thing to do being to keep the boat straight on. Sometimes it was necessary to land and pull the boat over a bump of mud or round a too sharp curve. As the boat completely blocked the bed of the little channel, the water collected rapidly behind it so that it was quickly raised and shot forward at great pace. I used to sit in the middle of the boat as low as possible, with one paddler astride the prow and another astern, their feet just tipping the water. If anything interesting came in sight it was possible to get a shot at close range or land for tracking. When the tide turned it was necessary to come down with it so as not to be left stranded far away in the forest. The great drawback was that our movements were controlled by the tides, which made it impossible to reserve the more comfortable hours of the day for the work in hand.

The whole of the Sunderbunds is teeming with life of every sort. I still regret not having been more learned in every branch of Natural History to make the best of my trip there. Forty-

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two years ago knowledge of the subject was yet, to a certain extent, in its infancy. What had been printed was scarce and difficult to get. We were explorers.

I joined my boats, sent ahead from Calcutta, at Mutlah and Canning, and began travelling with the tide. I went east to Bampurah, then to Sahabkhali and the Jaboona River. There were some cultivated rice fields on the way. A few natives of rather wretched physique took a great interest in my boats and kept following them on the bank. They were handling quantities of a fairly large fish with a very hard skin and an enormous flat head. They used to rub them sharply on the boards of their boats so as to soften the skins before eating them. A tiger had followed a path along the river. Numerous tracks of others were to be seen everywhere. Muggers were fairly numerous, and birds of prey of many sorts conspicuous all over. One of them, a large brown buzzard with a white head and chest is common all over the Sunderbunds.

Near Patang, the Jaboona may be about four hundred yards broad. By a small branch of the river I got a short cut to Bungsipore. The crossing was made during a dark night, with branches of overhanging trees brushing the decks every now and then. Jackals were howling at us along the banks and the men insisted on my keeping on deck with a rifle, afraid of a possible tiger coming to pick up one of them. I don't yet believe that there was really any risk of that sort.

Bungsipore was teeming with birds of prey, waders, and several species of heron. Here, I enlisted two so-called shikaris who pretended to know the Sunderbunds, and went with them for a stroll ashore.

I found rice fields all along the limits of the forest. To protect them against game, very long and coarse nets, made of bark, were fixed on posts over six feet high and machans for watchers were to be seen at frequent intervals. Footprints of wild boar and spotted deer were exceedingly numerous, and pugs of two different tigers were on the path, a sort of narrow embankment along the rice fields.

The soil was wet and muddy, the jungle very dense and the view was so restricted that I could not see anything. But I was introduced to a novel form of shooting. The men made me climb one of the big trees after them. Once fairly seated amongst the branches, twenty feet at least over the ground, they set up a growling, howling and shaking of the branches, in fact doing exactly what I should specially object to if wanting game. The reason for their behaviour is this:

A brown short-tailed monkey, going in packs of sometimes fifty is common in the majority of the Sunderbunds. The deer are quite used to them and to their antics and seek their company. When these pugnacious brutes dispute or fight amongst themselves, they break small branches in the trees and the deer then get the leaves which fall to the ground. This is their staple food as no grass grows in the forest. It is an interesting example of commensalism. That is why an imitation of the noise made by

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monkeys attracts the deer. I tried it many a time after and shot a few deer coming under my tree.

Some marvellous birds passed quite close to me. One, a glossy black racket-tailed drongo shone in the sun like silver. The broad terminal tufts of its wire like tail feathers appeared like two butterflies following its flight. Another black fellow, probably a species of king crow, had a fine forked tail. A little later, a dark brown squirrel with a sharp pointed head, a very long tail with rather short hairs, came to eat some leaves at a few feet distance only. He was darker and a little bigger than our common squirrel. This I gather may have been some species of tree shrew and there were always troops of short tailed macaques in evidence.

On the main river, from four to six hundred yards wide, many muggers were basking in the sun on the sloping mud bank. Some appeared to be enormous—the great majority about ten feet long. When coming out of the water they generally go up the bank and then turn round so as to have the head looking down on the water. As the mud slopes at a fairly steep angle they have only to glide down to get into water again. They do it extremely quick. I lost many wounded or dead ones tobogganing in that way. As the rivers are very often fifteen to twenty feet deep, and the muddy slope goes right down, any mugger moving is lost. I never saw one floating at any time, though I shot many when coming back to my boats in the evening. I measured a large one, shot dead in a patch of flat mud and found it to be 21 ft. 5 in. I lost another looking a little bigger. I dare say they have been shot a few feet longer. They are all of the broad mouthed variety, supposed to be possible man-eaters. Without saying decidedly that they are not, I don't believe it; because not only did I never see one take a man, but I can almost say the reverse.

During all my stay in the Sunderbunds, I had muggers in sight almost continually. I shot a good many heads of various game and, after cutting what I required, used to push the remains overboard, in the water. When anchored in the same place for several days, each tide brought back the bodies thrown overboard, so that they passed to and fro, twice a day. No mugger touched them, and there were hundreds all about. All the same I should not like to trust one, and never refused them a cartridge when it did not interfere with my sport. I remember vividly two experiences in which muggers played a dominant part. Once at sunset, paddling back after a long hard day in difficult jungle, I was drifting slowly with the tide in the small dinghy, surveying the bank of a large river. At any turn I expected to come on a rhino I had been tracking the whole day and which I knew to be not far away. The dinghy was, at most, eighteen feet long and three feet broad, I sat low down in the middle to balance it properly. The two men, fore and aft, sat astride on the narrow ends of the boat, their feet just tipping the water. Every now and then they slowly and silently touched the water with their paddles so as to guide the boat. Left hand on the gunwale, with the barrel of my rifle resting on it, I intently took stock of everything coming in sight. Suddenly I had the

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impression that the colour of the water under my left hand, along the boat, was undergoing a change. At a certain depth the muddy water was getting greyish, then slowly, the dim, almost foggy, patch took the form of a large mugger coming more clearly into view as he rose alongside the dinghy. Just under my left hand I could see his outstretched toes, then his grey wicked eyes broke the surface of the water without hardly a ripple. He floated alongside for a short distance, then sank slowly down without a move and faded away in the muddy depths. A small bubble rose to the surface and stood there for a while and it was all over. It was so unexpected, so ghost-like that I could hardly believe it. I think he came to see what we were. The slightest move from any of us might have spelt disaster. The forward man had his feet not more than three feet from the tip of the mugger nose, he never saw anything, and just turned round to inquire what it was when he heard the man astern muttering something.

Sometime after this, I was trying for tiger about fifteen miles south of Issuripore. The jungle there was extremely dense. After being reclaimed for cultivation at a distant time, it had been given up as hopeless. In deep forest, a sort of embankment, about three feet high over the surrounding ground, afforded a narrow path. It ran some 2,600 paces, at right angles with the river and then took a right-hand turn for another 1,500 paces. Tigers used this open, narrow and dry *bund* during their wanderings. I tied a goat as a bait, and sat up for them at night. One night, at about eleven, with a glorious moon, having seen nothing, I started back for my boats. The tide would not allow me to return much later. The path I had to follow was the only one, and a regular one for tigers. Fully expecting to meet a tiger there I walked first, rifle in hand, my two men following with two spare rifles. Shortly after turning the corner, some 2,600 paces from the river, I heard a move ahead in the heavy jungle on the right of the path, about ten yards away. I stopped sharp, rifle at the shoulder, fully expecting a charge from a tiger. A short silence, then a slow movement in the low branches, as if an animal was making a cautious advance in my direction before an open charge. Then came a rush straight at me and out of the low branches emerged the ugly head of a mugger which I shot dead. He was an ordinary mugger not particularly big. The distance to the nearest water, over deep muddy soil and heavy jungle, was at least 2,500 paces. He may have meant business, but what interested me was to have proof that these brutes do travel long distances out of the water, at least at night in the Sunderbunds.

Spotted deer were common all over, right down to the sea. I several times heard them braying or calling, without any apparent cause, in the middle of the day. One of them even answered our poor imitation of its call and came a certain distance our way. They don't seem to grow particularly good heads there. Hog deer were also to be found, at least half way down to the sea. Both these deer feed exclusively on leaves as there is no herbaceous vegetation in the Sunderbunds. The low branches are devoid of leaves to a certain height as if pruned and I even saw one stag

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standing on his hind legs to reach some branches just as Waller's gazelle does for the same purpose. Round broken leafy branches their tracks are many. They drink the brackish water of the rivers.

Wild boar with good tusks are common. I found them mostly when going with the dinghy through forest. They appear to eat the roots of the screw palms along the water edge and certainly rely a good deal on crabs, which are about in enormous quantities. There is also a sort of tree with a large round fruit which splits in four and is full of closely pressed seeds. I found these trees in one or two places when tracking rhinos and they are common near the seashore. They grow small, thick, darkish-green almost round leaves. Boar tracks were profuse round them in the north, where my men were very much interested in them and told me they had never seen them. By the sea they were many.

Otters may be the commonest animal in the Sunderbunds, I never missed seeing their tracks anywhere from north to south. They travel overland and may be seen anywhere at any time. They are not much above ten to twelve pounds in weight and generally travel in twos or threes. I even once saw eight in a row following each other. They are great crab hunters and break the heavy shells without effort.

On certain mud slopes exposed, at low tide, to the full sun one may see scores of a little brown fish, about the size of gudgeon, resting on its two enlarged pectoral fins, near vertical holes which they dig in the mud. At the first sign of danger, with a jerk of the tail, they dive into their holes and disappear. But not for a long time. Soon one head will show here and another there. A gentle tapping on the mud with a stick will induce some of them to come out to inquire. At high tide all their holes are under water and must be blotted out. But they burrow again as soon as the water recedes.

A brute which gave me a lot of work for nothing is the Monitor Lizard. Once, when going up a tree to call stags I heard a commotion in the leaves overhead, then a bump on the mud twenty feet lower, then a great splash in the water and a dive? What could it be? '*Gua*', said my men. But what on earth was a *Gua*? What is it made like? After long and complicated explanations I laboriously made out that the *Gua* was a large animal, climbing trees like a monkey, diving like a mugger, with the long claws of a bear, head of a python and the body as large as a child's. With that description I wondered whether there was not in the deep jungles of the Sunderbunds, an unknown animal within reach of me. If I could only get a glimpse of the brute? The tracks showed long-clawed toes and something dragging on the mud between them. Then I set to work until finally I found a large lizard which I shot. There was the *Gua*—a species of Monitor, 66 in. long. The description was not very far from the mark after all. After that I saw many others. Once at the mouth of the Malancha, near the sea, five of them, one after the other, dropped from a tree almost on the top of me, in their fright and rushed to the water.

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Snakes, in spite of periodic flooding at high tide of many islands, are not rare. When passing under the jungle, in the dinghy, carried on a very swift tide current, a yellow cobra swam hurriedly across, just in front of the boat, and went up the sloping left bank. The impetus made us shoot past before the snake was yet quite up the slope. The fore end paddler lifting his feet fell back into the dinghy, I, sitting in the muddle, had to lean as much as possible to the right. The snake was not two feet distant when we passed and the rivulet was so narrow that I was afraid the gunwale might catch its tail and roll it against bank, bringing it back into the boat in the worst of temper. In fact, the margin was only a question of inches. Another day a large python happened to be coiled just on the very brink of a little river when we passed it with our heads level with it. The snake did not appear to notice us. There was only a slow heaving move of the coils. As we were then on a rhino's tracks, and trying to head him, I did not get the snake. Its thickness pointed to a big one, but I never saw the head.

Insects of any sort, even mosquitoes, are certainly not abundant as, in my notes, there is no mention of them. Probably the brackish water does not agree with the larvae. I don't remember even seeing a butterfly. Once, on a tree, I was stung by a long, slender, black ant which could sting like a wasp. The sting, with a minute drop of venom, could easily be seen when the ant tried to drive it into one's skin. It could not penetrate except in the very soft parts of the hand. The pain was trifling and did not last more than a few minutes. This ant, at the slightest vibration of the tree, went hurriedly to cover on the underpart of the branches where it lay flat and motionless for a while. Probably it was its way of escaping certain woodpeckers which I never managed to see but which I heard several times at work on the trees.

The wealth of the Sunderbunds lies in its birds. In deep jungles they may be scarce. Excepting the black drongo with the long tail, the one with the forked tail, and another black species, few birds are to be met with. But, along the river, there is a marvellous display of the most gorgeous plumage. Kingfishers swarm all over, birds of prey and wading birds of different species are common. I tried, in the Calcutta Museum, to find out something about them and made out that *Dissemurus paradiseus* and *Bhringa remifer* were the scientific names of two of the above Drongos. A spotted eagle was *Spilornis melanotis*, a fishing eagle *Haliaëtus leucogaster*, a grey hornbill, *Meniceros bicornis*. But I could not go any farther, in 1892! This is a short list from my diary.

I saw no ducks or geese whatever, no divers; some of the waders were the same as we see at home. The red-legged sand-piper seems to me, with the grey heron, the most ubiquitous bird in the world—(A year later I was confronted with two of them at the small lake in the Kilik Pass, at an altitude of roughly 18,000 ft.). Several other shore birds had a very familiar aspect, but they are so difficult to distinguish from each other that I will not say anything more about them. In January, swallows were in small flocks

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by the sea going north, curlews, whimbrels were many at the mouth of the Malancha, and our fishing eagle, *Pandion haliaëtus*, was common. But what of the rest? Herons of several sorts were by the sea or along the swamps of the north fringe, night herons, white herons and red, snake birds perched on the dead branches all along the Eshamuttee and other rivers. Crows and black or grey vultures were in evidence on the north side, nightjars appeared in numbers every night specially on the Kudum Tullee and Pizzon Khalee Rivers, I even saw a large owl, a sort of Eagle owl. I jotted down the following list which I copy from my diary.

Large white eagle, span of six feet, slate colour over back and wings; beak slate grey without any special colour at the base on the lore, fairly long tail with a white cross bar at the end (Arabi Bankee River).

Malancha River. Large heron, red brown under, iron grey on the back.

Malancha River. Fishing eagle, grey head, body brown, legs, lower parts of the body, under parts of the tail, pure white; a brown bar at the end of the tail.

Fishing eagle black and white, with bright red legs (Eshamuttee River).

Large black storks, under parts of the body white, neck yellowish and naked, light crest of feathers at back of head.

Large brown eagle.

Brown eagle spotted white; yellow bill fading to blue in certain parts, longish stiff feathers at the back of head.

Black and white eagle with stiff feathers as a crest, at the back of the head.

Of the kingfishers I specially made notes of the following ones. A big one, about the size of a dove, with a long coral red bill, head and underparts yellow, back and wings brown, light bright blue above the tail. Another smaller one black, white and blue.

Then a white one, spotted black. (I saw one of his species in the Suez Canal hovering along the ship two years later.)

Another, very much like our home kingfisher in size and colour, but certainly brighter all over.

And yet another almost exactly similar in shape and colour, but so minute that I believe it is hardly as big as our blue tit.

Jungle fowl were common, specially in islands 170, 173, 174, 179, and down to the sea. I think they were *Gallus ferrugineus*, smaller in size than our domestic fowl, dark red and black, with bright yellow feathers at the root of the tail. Some had a yellow head with naked white patches on the ears.

About the jungle fowl my men told me a story which may or may not be true but there it is.

When I was on the small Lullabeer Doanea River, north of island 182, I was asked not to shoot any jungle fowl there, as I often used to for the pot, because in that particular island, a certain god, *Bandeao* or *Banadeo* by name, did not like it and repaid with the worst of bad luck anybody not taking his wishes into account. He was a little known god whose existence, in that part of the Sunderbunds, had been disclosed, in a dream, to

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a very holy headman of a distant village in the north. The god did not allow anybody to cut wood in this same island. I am not absolutely certain that this beautiful story had nothing to do with the anxiety of my men not to stay any more on that small river, where, during the night, we had heard two tigers roaring as I never heard one roar before or after. But as it was extremely hot there, in the middle of the day and fearfully dense jungle, and as I was on my way farther on, I obeyed the order of *Banadeo* very readily.

All the animals living in the Sunderbunds have to lead a special life under peculiar conditions. I saw monkeys drinking the brackish water; tigers, which are many, have to do the same and think nothing of swimming across rivers nearly half a mile broad. I saw this at the mouth of the Malancha, and had ample evidence of their having done so in many smaller rivers. Jackals, common on the northern border, are unknown further south, and may object to brackish water and swimming. Deer and wild boar are quite happy with both, even the pretty Fishing Cat *(Felis viverina)* which I found in island 169, must feel happy with it. But, I think, buffaloes and, I am certain, rhinos need sweet water.

Of buffaloes I have very little to say. There was not one to my knowledge anywhere south of Issuripore, but in the north where there is also dense jungle and several islands covered with thick jungle, there were one or two small herds of them. I am not certain that they were not tame buffaloes turned wild, after some cultivated parts had been given up. As the domestic water buffalo (and they were water buffaloes) is identical with the wild one, it is hard to tell; and I did not trouble much about them, seeing that I was going to Assam later. I just spent two or three days after them, and had proof of their high jumping capacities. Three of them when disturbed, jumped frog fashion into a river from a high bank, certainly twelve feet above water level. The splash was magnificent. I treasured the fine sight in my memory. Ten years later, when trying to spear hippopotami by the Aouash river in the Danakil country, a hippo that I had intercepted on his way back to the river and speared with a large Somali spear, took a clear jump from the bank into the river from a measured height of 14 ft. That was a sight by moonlight.

In January and February 1892, rhinoceros were to be found at only one place in the Sunderbunds as far as I know; and that is in islands 165, 172, 171, 170, 169. There may have been rhinos farther east or west, but here where there is a maze of forests, islands and rivers, I spent days and days tracking them. I penetrated this slough of deep slush and clammy heat, going through the most abominable mud-covered thorny thickets, without ever seeing an open space ten yards across. The rhinos lived there for one reason. In the middle of this jungle there was sweet water. How is it possible to explain such an occurrence in this delta, where two mighty rivers, the Ganges and Brahmapootra, have slowly filled up the Bay of Bengal with alluvial soil, washed down since centuries from the Himalayas, to a depth of seven hundred feet over a surface of many square miles? But the fact remains: some pools of sweet water are to be found in the jungle about

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fifteen miles south of Issuripore, while the whole country is surrounded by tidal rivers of brackish water and inundated with salt water.

The first rhino tracks that I came across were when after crossing the river Pizon Khalee, I was going up a steep mud slope. They were deep tracks, the hind foot stepping exactly into the spoor of the fore foot, the central toe boldly cutting the ground, and the two lateral toes just tipping it in hard places. Foot a little broader than long. Soft parts of the foot, behind and between the toes, very hard and without any wrinkles. In this character the Sunderbund rhino differs from other rhinos living on hard soil. The foot is decidedly broader than the girth of the leg as, even in sinking, as is the rule, over ten inches in mud, the leg itself does not touch the walls of the foot hole. The foot is lifted, and comes out absolutely neat and clean, without any drag of any sort. Inspection of the lower part of the hole shows that the weight of the body does not make it expand as would appear likely under the pressure. The animal must be extremely tough, and apt to a lot of work. The hind foot steps exactly into the print of the fore foot. It is a little smaller and more oval. It seems also that the hind foot rests on the ground at a little outward slant. The beast goes at a quiet slow walk, under the big trees and through the heaviest thickets, without paying the slightest heed to obstruction. The spoor is made in a regular zigzag line like a cat's track on snow.

A rhino browses very steadily. He is quite at home. No flies to disturb him, he seizes the tips of branches in his stride without altering the position of his feet in any way. He does not trouble to move his head right or left to inspect his food. He does not pull at a branch sideways, as so many browsing animals do; the branch is crushed and cut sharp without a move of the head. His meal lasts until late in the morning, his tracks lie over the ones left by numerous crabs, which travel about mostly before nine in the morning. He does not rub against any tree but rather avoids them. When he goes into a thorny or leafy thicket, he does it as a needle piercing a cushion. The sort of tunnel left behind is hardly visible and, at most, three feet high, as the branches spring back almost exactly. After an hour's careful tracking I came to the conclusion that I had to deal with a very tough and hardy animal which was going to give me a lot of work and which might be found on the move at any time of the day. For the rest: the food specially selected by rhinos, the difference in the footprints of male and female, the surface of ground covered in an average day, the number of animals in the area of jungle inhabited, their peculiarities and minor habits and so on I had to trust to time to learn them. I was beginning a course of intensely interesting study.

I started it, in earnest, and kept at it steadily. There is no use in hurry. It is a mistake to jump to hasty conclusions. Everything is written, for a patient tracker in the footprints of an animal. In this terrible jungle, plodding along in deep mud with the temperature like a steam bath, in the close atmosphere of these deep forests, I kept for days and days on the track of these

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rhino coming on them several times at close range, in places where it was impossible to see anything. Once, when wet and tired after a long day, I saw, betwen branches and leaves, a long grey head only a few yards away. It had no horn—no trophy. Why shoot for the lust of killing only? The rifle just touching the shoulder came slowly down, the rhino went off unscathed; as I had suspected it was the Lesser one-horned Rhino (*R. sondaicus*) exceedingly rare! It is forty-two years ago now and I don't regret it, sport is not slaughter, killing a very rare animal, without a trophy as an excuse, is criminal.

I should say that, at that time, there were only three rhinos in this part of the Sunderbunds—perhaps four at the most . They were all the same size, full-grown animals, without much to choose between them. They were generally on the move without following any beaten or regular track. My average day was this.

As early in the morning as the tide would allow, from my dinghy I inspected the banks of the rivers until I found a fresh track. If a little river through the jungle was available I used it as far as possible, and then made a detour across to come on the track again. If none was handy I landed and followed the spoor at once. Sometimes the track led under big trees where the going was a little better, oftener, through dense thickets of various sorts. At spring tides these were inundated and the whole vegetation, up to several feet, was smeared with dried mud which fell in a shower of dust, when forcing a way through. Some of the trees were rather like hollies with heavy thorny leaves, others might have been a sort of *Dracaena*: straight stem about the size of a man's arm from six to ten feet high, then a bunch of arched leaves fringed with hard thorns. Quantities of dead leaves projecting all along the stem were most objectionable. Often, the only thing to do was to go under, on all fours; but, with the mud, it was not pleasant, and the rifle had to be kept above ground.

The rhinos travelled singly, only occasionally did I see tracks of two together, and that only for a short time. Following them led to the discovery of some strange ruins, near which I came across some small ponds of sweet water. They were the reason of the rhino's presence there. Under tall trees and in the middle of patches of thorny bushes, were some mounds of earth, slightly higher than the surrounding ground. It was so abnormal to find a dry place in the Sunderbunds that I examined these mounds more closely to discover what they could be. There were old decayed bricks rather like those found in the ruins of Issuripore. Some of the mounds were built in a row, almost in a straight line for about one hundred yards. On the other side of a small river, were one or two more. The vegetation, owing probably to a slight upraising of the soil, was a little different there. One tree, with an extremely hard brown wood and long oval dark green leaves, grew there. Another, overgrown with creepers, had been fairly choked: its dead trunk was visible through a network of ashy grey creepers which terminated high above in a magnificent canopy of green leaves. One of the mounds had been hollowed out by some animal which had dug a burrow, hardly

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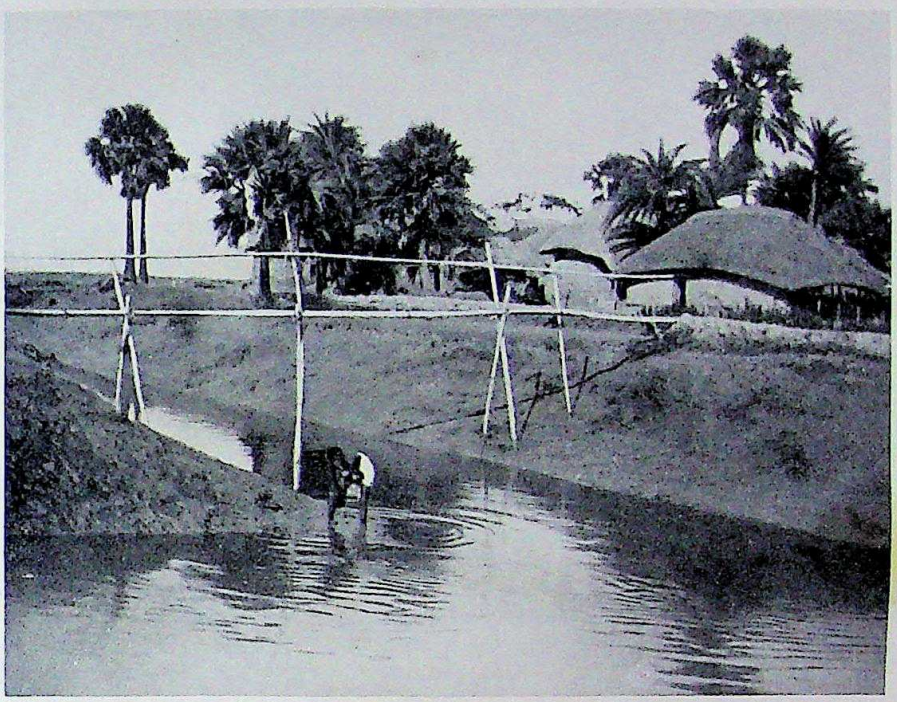
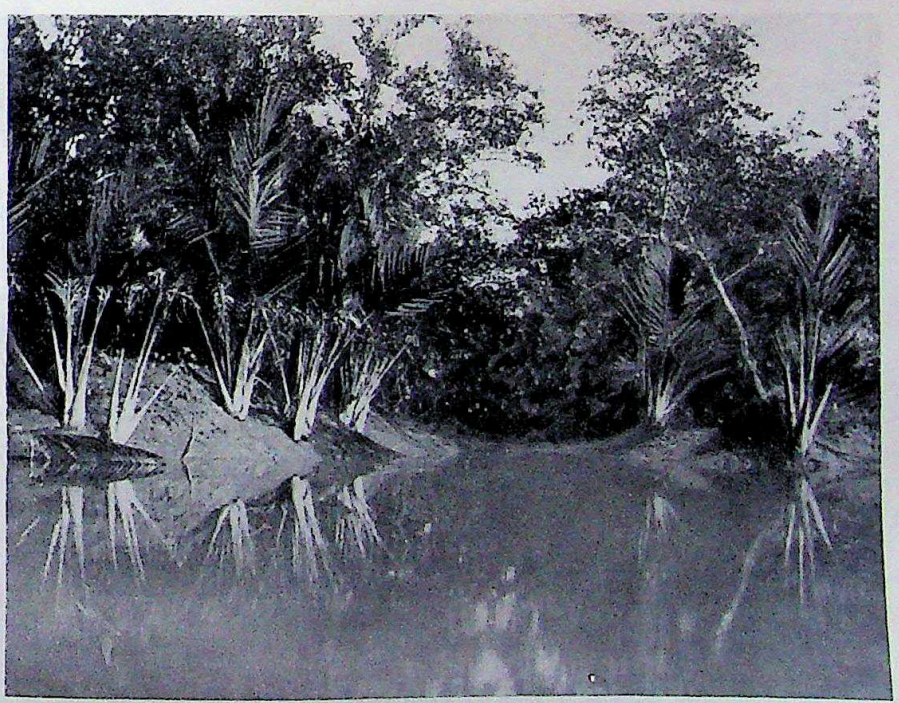


1892. North Sunderbunds—low tide—native dwelling with footbridge.



1892. A small river giving access to the interior of the jungle—low tide—big palms growing out of the mud.

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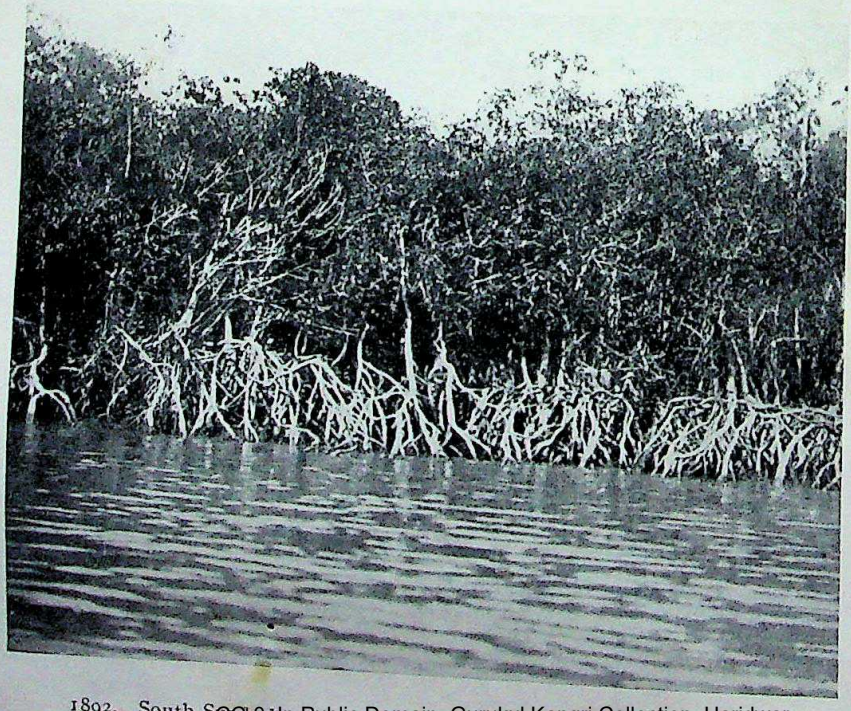
Sunderbunds, 1892. Half tide mud bank with fringe of big palms.



1892. South Sunderbunds near the Sea. Malancha River—High tide.

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bigger than a rabbit's. The soil all round was too hard and dry to bear any footprints.

For a very long time rhinos had wandered about the place. It was simply covered with and beaten flat by their tracks. Dung, which they don't seem to drop regularly in fixed places like the other rhinos, was to be seen there and also a few places where they had lain down. Some ponds of sweet water were scattered about, none more than a few feet across except one, much deeper than the others. This particular tank might have been twenty to thirty yards broad and of an unknown length as it disappeared under overhanging trees and creepers, and I could not go round it.

Waiting at night there was impossible, so close was the jungle. I tried several times to find a rhino there, either lying down, or standing motionless for hours, as they do, but never succeeded. I was afraid of disturbing them too much, as when disturbed, they go off for several days without coming back. It made me believe that they might have other sweet water drinking places somewhere in the unknown parts of the forests. If not, they may go without drinking for several days.

The river Pizum Khalee seems to be the centre of their wanderings. They often swam across it. I even saw unmistakable signs that they sometimes swam long distances up and down the river. One day a rhino went up river and fed on the leaves of branches overhanging the water. The depth at this place was certainly over ten feet. A long smooth furrow along the vertical muddy bank was proof of his rubbing against it and showed that he had kept in the river for over four hundred yards swimming along the bank. Several times I had proof of their prolonged swims.

It seems that they travel long distances in almost a straight line at a long easy stride without taking much care to keep to special runs. Arriving at a favourable place, they roam about over short distances turning over and over again on their tracks. As the jungle is very often extremely thick, tracking is difficult. Again, when leaving such a patch of jungle, they make in a straight line for another favoured spot which may be several miles away. But the proof that they travel to a known destination is that I never saw them going north or south but exclusively east or west. They know exactly where they want to go. I tracked them for five or six miles in a straight line several times. It was always the same long easy stride, keeping unerringly in the same direction. The difficulty of coming back to my boats, at the time when the tide would be right, did not allow me to see the end of their journeys.

The jungle was so extremely dense that my range of view was very limited—at the most under twenty yards. On several occasions I kept in close proximity to the rhinos for a fairly long time, following them, marching parallel with them, trying to head them. In this very close atmosphere it seems that scent does not travel far; so still is the air. I could hear them browsing, pulling their feet with a dull flop out of the mud, breaking dead branches

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in their stride, all very quietly and slowly. When quite near I took great care never to move except when they were moving themselves or munching, so that any possible noise might be covered by the sounds they were making themselves. Sometimes, when on all fours under cover, I happened to be nearer than I thought comfortable. Once I got a glimpse of a huge leg very near indeed. Another time some branches were shaken by a rhino very near my head. If I had only seen a part of the animal it would have been possible to guess where to shoot; but it was never possible to see one clearly. Certainly these rhinos are not quick tempered and apt to charge like the black African rhino or even the Assamese species. Any of these would have resented my close proximity. Instead of that, when after a while, one got suspicious it stood absolutely motionless for a long time, once certainly over ten minutes. I remained absolutely motionless also, wondering what would happen next. I found it extremely trying. Then with a rush of a few yards through the dense undergrowth, then a long stop again, then another rush, off he went at a long stride making a bee line for some distant jungle patch unknown to me. For at least three miles he went straight on, never galloping, but ambling, and putting his hind foot over, and cleanly in advance of the fore-foot.

One evening, when after tracking vainly the whole day, I was slowly paddling back to my boats, I heard a branch breaking quite close to the river bank. A rhino was leisurely following the margin of the river. I kept along the bank for a long time expecting him at any minute to show a bit of himself or even swim across. But he kept inside the deep jungle, never more than a few yards away, until, when it was pitch dark, he got a whiff of my wind. Then he stood motionless for a long while and after a short rush, stood again, then made another rush and went off for good. The next day I read these movements in his tracks. The dinghy was not much above ten yards from him when he got to know we were there. The first rush was not more than ten yards; when he stopped, he turned round as if trying to look behind him; the second rush was about forty yards. The tracks were wide apart as if, with the head up, he had been looking right and left over his shoulder, a common habit with all rhinos. Then he had come back a few paces along his track, and stood for a while moving his fore feet several times and, finally, he took a bee line, at a long easy stride, to some distant part of the forest. I tracked him for four hours without result. Some people would say that, when he turned on his track, he meant business and was ready to charge. I say: no. Many animals do this when disturbed without being much alarmed. They look over their shoulders or turn round to look behind when they stop. Sometimes, out of sheer curiosity, an animal will come back on its tracks, and may appear as though viciously waiting to catch the intruder. But it is curiosity not mischievousness. Animals do this when they don't know exactly what the cause of the disturbance is. When they start again, they turn sharp, head held low and sideways, gallop for a few yards, then break into a long trot, tail up or flourished

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rapidly, head carried high to look behind over their backs. After a while the head comes lower and the animal goes away at a steady trot or gallop. Buffalo, of every sort I know, act very often in this way. I do not mean to say that many an accident has not been caused by animals waiting by their track, in deep jungle, and charging the hunter following the direct one. But it is not calculated action as many people would believe, it is mere reflex and normal action. The animal wants to make out the cause of the disturbance, he stops and goes a few steps back. But a bulky brute does not turn sharp on his feet, he does it in a curve and that curve brings him out of the main track and alongside it; when resuming his flight he will often take a new line. Many an accident and many a rash conclusion is derived from this very simple manoeuvre. A wounded animal, or even a disturbed animal, may take the chance offered and charge viciously. In such a case, he but takes his opportunity, he does not make it as many people believe. If people want to go for so-called dangerous game they ought, first of all, to know better than keep blundering about, as is so often the case. I consider that these rhinos that I found in the Sunderbunds were not as quick tempered as other species. They had many a chance to come for me or turn 'difficult', but never made the best of such chances. The Assamese rhino would have been different though they are not to be compared with the African species. These last would have turned me out of this dense jungle in no time.

The opinion which I acquired slowly made me wonder if they were not another species. At the time, the problem of *Rhinoceros sondaicus* was not much discussed, forty-two years ago all these questions were not yet to the fore; but my suspicions so aroused made me observe them better.

One thing which struck me first was the complete absence of places where a rhino had been wallowing in the mud. I never saw any. They very rarely rubbed against trees as the other species so commonly do. This may arise from different causes; perhaps from an exclusively forest life. But in one place where one of them had been lying down I could faintly discern that the skin, where not rubbed and polished by the branches, was something like a mosaic, leaving on the mud a sort of network of little lines. That was queer. Then I found a tree where a rhino had rubbed his head and cheeks. In a case like this the marks start at the level of the head, held horizontally or raised, but some mud, sticking on the bark, showed that he had lowered his head almost to the level of the ground. That is generally evidence of an animal turning its head sideways and trying to scratch it over the nose. That could not happen if there was a horn, and a horn would make a mark on the bark of the tree, if the rubbing had taken place just behind it. But then he had rubbed both cheeks, one after the other, on both sides of the tree, and left no mark when, with his head very low, he passed his nose from one side to the other? And finally, as explained above, I got a glimpse of a strange profile at a very short distance. For the first and, I am sorry to say,

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the last time in my life I saw that long, grey, hornless head and everything was explained: these rhinos were *R. sondaicus*, they had no trophy worth having and shooting them was without excuse.

What has become of the Sunderbund rhinos now in spite of the extreme difficulty involved in their pursuit? They were then very few: I am certain of three, I consider that a fourth is probable, and that six is the maximum. They are probably shot out. Even when I was there, poaching was rife in the Sunderbunds. Boats coming to get firewood for Calcutta had generally a gun on board. Almost every two or three days I heard a distant shot somewhere in the forest: it meant food for the boatmen. I also met one small boat which came to beg for some water, on board were two men and two guns. They disappeared to the south. The Government in response to some, absurd but misplaced, philanthropic feeling, I have been told, gives fifty rupees as a reward for every tiger shot in the Sunderbunds. That is enough to start poaching to an uncontrollable extent. I do not intend to say that any regular rhino-shooting ever took place; but, certain it is, that any of the poachers meeting one of them either in the forest or, more probably, crossing a river, would take a shot at one. That is enough, wounded or killed it is one less, and there were none to spare. Nobody took the slightest notice: white men did not go out shooting much in the Sunderbunds in my time, I don't think many have done so since. What does it matter if one more of the rare animals of the old world is extinct? Still, amongst the most cherished souvenirs of many years big game shooting in the world, in spite of a great many drawbacks, these days in the strange stillness of the big Sunderbunds forests are among the best.

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NOTES ON THE BIRDS OF THE SITTANG-IRRAWADDY PLAIN, LOWER BURMA.

BY

J. K. STANFORD, I.C.S., O.B.E., M.C., M.B.O.U., F.R.G.S.

These rough notes were made between April 1929 and November 1932 in various parts of the Henzada, Insein, Pegu, Pyapon, Maŭbin, Hanthawaddy and Thaton districts of Lower Burma. My excuse for putting them on record is that, since Oates published his *Birds of British Burmah* in 1883, practically no one has collected in the huge area which lies between the mouth of the Sittang on the East, and the hills which fringe the western side of the Prome, Henzada and Bassein districts.

The area is drained by four large rivers, the Sittang, the Pegu, the Hlaing (or Rangoon) river, and the Irrawaddy, and their tributaries. It is bounded on the east by the heavily wooded left bank of the Sittang, down the centre runs the line of the Pegu *yoma*, and along the western side the foothills of the Arakan *yoma*. Though a vast amount of swamp and forest land since Oates' day has been cleared and converted into corn land, though the southern half of the heavily-timbered Pegu *yoma*, running down to Rangoon, has long been stripped of all but its scrub and bush jungle, though the line of forest reserves which, in 1912, stretched from the Sittang to China Bakir and beyond, has become one endless paddy-plain, yet there are still enormous areas, difficult of access, which are, it is not too much to say, less known by naturalists now than they were in 1883.

There is now but a small remnant of the swampy forests bordering the Sittang which in 1883 formed a stronghold for Pelicans and Adjutants, in the breeding season. At the southern end of the plain, the remnants of the old primeval woodland, and of the forest avifauna which peopled it, still survives in the Zepathwe reserve near the sea. But despite these changes, rapid as they have been, there are still vast solitudes in the *yomas*, and along the seashore, as inaccessible and quite as little known ornithologically, as they were fifty years ago. The dense evergreen foothills of Insein and Pegu, covered with *wanwe* and *wathabut* (bamboo) jungle, the Lemyethna and Kyangin foothills bordering the Arakan *yoma*, covered with *kayinwa* (*Melocanna bambusoides*), which resembles, as someone described it, 'miles of corn fields grown to nightmare height', and the enormous area of tidal mud, intersected by creeks and fringed with mangrove and willow jungle (*Sonneratia apetala*) are still almost unknown to the naturalist. To give but two instances, Armstrong's Sandpiper (*Glottis guttifer*) has never been obtained by anyone in Burma or India since Doctor Armstrong worked the river near Elephant Point in 1875-1876.

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Jerdon's Babbler (*Pyctorhis altirostris*) has not been recorded by any naturalist since Oates, in 1883, stated that it was 'very abundant in the Rangoon and Shwegyin districts'.

These notes are most incomplete, and the gaps in them will show Burma observers how much remains to be done. I started collecting in Henzada in 1930, with the assistance of Mr. E. Henricks, whose services were again lent me by the courtesy of the Bombay Museum authorities. Our task had to be dropped abruptly in February 1931 on the outbreak of the Henzada rebellion (which had been simmering for two months previously), and it could only be resumed in a partial manner later. I am indebted to Mr. Henricks and to his successor, Mr. W. Stubbs, for their painstaking work done often under very trying and difficult circumstances.

To Doctor C. B. Ticehurst, M.B., M.R.C.S., M.B.O.U, F.R.G.S., who has identified the skins sent home, and has at all times given me invaluable advice, my grateful acknowledgments are also due. His notes are given in square brackets.

Most of all, I regret that I had little or no opportunity to study the birds of that wild and lonely area lying between Elephant Point and China Bakir. As remarked above, it is probably the one place, in the southern part of the Pegu division, where the original forest avifauna of Lower Burma survives more or less unchanged, cut off, as it is, on one side by the sea and, on the other, by a hundred miles of paddy plain. I do not know of any area in Burma so rich in varied bird life, or in which the bird watcher is so sure to find his time and trouble repaid. Beyond the paddy land there is dense tree forest intersected by creeks winding through mangrove jungle, miles of streams [fringed with willow (*Sonneratia apetala*), and a form of sea holly], which debouch through open sandy dunes, or on to unending levels of sand and mud, and which are covered at low tide by tens of thousands of wading and water birds.

The rainfall in the area varies from 90 inches in the South-west to about 65 in the North and North-east.

The number of skins sent home is approximately 400, belonging to 166 species. Others mentioned were fully identified in the field, or in the case of some of the ducks and waders, shot and not preserved. In all 291 species have been noted, and of these 3 are new to Lower Burma.

In his paper on the Birds of Rangoon (J.B.N.H.S., vol. xxv, p. 358) Colonel Harington recorded 152 species, of which those seen by him and not found by me were

Prinia flaviventris,
Alseonax latirostris,
Hirundo smithii,
Arachnothera longirostris,
Pitta oatesi,
Pitta cyanoptera,
Gecinus occipitalis,
Hemicercus canente,
Dichoceros bicornis,

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Cuculus micropterus,
Hierococcyx sparverioides,
Palacornis indoburmanicus,
Ketupa ceylonensis,
Scops bakkamoena,
Polioaëtus humilis,
Alsocomus puniceus,
Arboricola brunneipectus,
Turnix blanfordi.

Corvus coronoides subsp. JUNGLE CROW. ♀ 640.

Common, but only one was collected. Harington noted that where jungle crows take to living in or near towns and villages, they tend to breed smaller than those in the jungle. There is certainly considerable variation in size observable.

[It does not seem at all certain that our Indian jungle crows are races of the Australian bird (*coronoides*), or that the Burmese birds are inseparable from the typical Java form.—C.B.T.]

Corvus splendens insolens BURMESE HOUSE CROW.

Ubiquitous. Though they return to their breeding haunts in early February, they seem to start breeding much later, and I have found fresh eggs in mid-April.

I have seen crows flighting eastwards in January at dusk from the Henzada *yomas* at a very great height, and obviously coming from a considerable distance, in exactly the same way as Paroquets do. The noise made with their wings by a flock of *Corvus insolens* flying overhead, appears to be produced at will, in the same manner as a breeding male Lapwing can suddenly produce a resonant noise with his wings, when flying over an intruder.

21. **Urocissa erythrorhyncha magnirostris** RED-BILLED BLUE MAGPIE.

Local name:—*Hnget-aungma*. Common in the foothills of the Arakan *yoma* in Henzada. Harington and Wickham found it fairly plentiful near Rangoon and breeding at Taukkyan (Insein) in April, but I have not seen it there.

29. **Dendrocitta rufa kinneari** BURMESE TREE PIE. 501, 652.

Common in Henzada and Insein and occurs in the outskirts of Rangoon. A female shot in February showed signs of breeding. One seen on October 25th was just acquiring its new tail, the feathers on one side being complete, and on the other only half the normal length.

[This race is just recognizable on a good series. Single specimens cannot be differentiated. It was compared in the *Fauna* (i, 50) with *sclateri* (Chin Hills) but it is much nearer to *vagabunda* (Bengal) from which on a series it differs in having the head less dark, mantle less foxy-red and less contrasting with the head, and underparts less deep. A series of adults from Lower Burma ♂♀ measure: wing 140, 145-62; tail 220, 222, 236, 262, one 278. Tails run rather longer than in *vagabunda* but wing measurements are the same. Birds during their first year can be differentiated from adults by the less black flight feathers and by the pale tips to the tail.]

36. **Crypsirina temia varians** BLACK RACKET-TAILED MAGPIE. ♂♂♀ 605, 626, 651.

Not uncommon in the Insein and Henzada districts, even close to Rangoon. Those I saw along the Henzada *yomas* were in pairs in early February.

[Two ♂♂ measure: wing 118-122.5 mm.; tails 185, 195 mm.; ♀ wing 119 mm.; tail 187 mm.

The central tail feathers are less spatulate in the female than in the male. —C.B.T.]

37. **Crypsirina cucullata** HOODED RACKET-TAILED MAGPIE. ♀ 534.

Local name:—*Nabà-chu*.

I saw several in the northern part of the Henzada district near Pauktaing where *Argya gularis* also occurs. It may be a dry weather visitor, but in view of the fact that I saw one in Myitkyina in January 1934, and that

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Argya gularis has also occurred outside its usual range (the dry zone), further observation is clearly necessary as to this Magpie's distribution in the province.

[Venning first pointed out that in three specimens of *cucullata* there were only ten tail feathers. This I can confirm on half a dozen more and also note that *temia* has only ten tail feathers. This is very remarkable as I know of no other member of the Corvidae which has less than twelve.—C.B.T.]

51. **Parus major cinereus** INDIAN GREY TIT. ♀ 55.

It was interesting to find, as Armstrong did in 1876, that this Tit was abundant in the 'tidal jungle' near the mouth of the Rangoon river. Not only do the willow trees along the creeks attract it, but the old and dead trees in the remnants of primeval forest, which form the Zepathwe and Pilakat reserves, are clearly favourite breeding grounds. I saw it nowhere else, and should describe it as a rare bird over the greater part of Lower Burma.

112. **Sitta castanea neglecta** BURMESE NUTHATCH. 444.

Not uncommon in the Henzada plain and in places very tame. It is partial to tamarind and *kokko* trees. I have never seen it in flocks as I have *frontalis*, nor have I any records from the rest of the area.

119. **Sitta frontalis corallina** VELVET-FRONTED NUTHATCH. ♂ ♀ 623, 624.

I shot a pair on February 13th in the Henzada *yomas* which showed no signs of breeding, and saw a flock of six on the same date accompanied by Minivets and other birds. I have frequently seen this nuthatch moving about in small and very active travelling parties like Tits, mingled with other species.

128/129. **Garrulax leucolophus** subsp. WHITE-CRESTED LAUGHING THRUSH.

Abundant in Prome but seems uncommon or very local in Henzada, as I saw only one small party near Shwelaunggyin in the *yoma* foothills in February. In Insein also it is local, and not found near Rangoon.

131. **Garrulax pectoralis** BLACK-GORGETED LAUGHING THRUSH.

134. **Garrulax moniliger** NECKLACED LAUGHING THRUSH. 212, 505, 510, 511.

I have never been able to distinguish these two species in the field, and usually only by measurement in the hand. The only specimens obtained were at Kywezin (Henzada), where three shot in bamboo jungle in the *yoma* foothills were undoubtedly *moniliger moniliger*.

A male out of a pair shot at Aukkanyinmyaung in May 1932 on the eastern side of the Pegu *yoma* was identified as *moniliger fuscata*.

[An interesting problem in distribution yet remains to be solved with regard to this common bird. The *Fauna* gives the distribution in Burma of *moniliger moniliger* as 'Northern Burma or Northern Shan States', and of *moniliger fuscata* as 'South Central Burma to South Tenasserim'. Mr. Stanford's Kywezin birds are undoubtedly *moniliger* with white tips to the tail, which are buff in *fuscata*. In the British Museum are typical *moniliger* from Thayetmyo or 'Pegu' but others labelled 'Lower Pegu' are *fuscata*. Of birds labelled 'Toungoo', some are typical *moniliger* and some are more or less typical *fuscata*. Possibly *moniliger* is the hill form, but this needs working out.]

191. **Argya earlii** STRIATED BABBLER. 3 ♀ 422, 586, 587.

The commonest bird of the Henzada riverine plain where Oates noted its abundance. It occurs in Insein, Pyapon, Maubin, and Pegu in the *kaing* grass areas, and was seen in family parties from December to July.

194. **Argya gularis** WHITE-THROATED BABBLER. ♂ ♂ 538, 551.

As already reported in the *Journal* (vol. xxxv. 15th November, 1932) I saw a few in the northern corner of the Henzada district at Pauktaing in January 1931 and obtained two specimens. This country approximates fairly closely to that of the dry zone and seems to be a continuation of the Prome-Tarokmaw ridge on the other side of the river.

In May 1932, I saw a party on the laterite ridge south of Mingaladon aerodrome about ten miles north of Rangoon on several occasions, and a single bird on the other side of the Rangoon-Prome Road. On September 25th, I saw a single bird on the 'General's Mile' at Mingaladon and on November 5th a

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party of four near Tadagale lunatic asylum, two miles further south. It is difficult for me to believe that these birds were not migrants or waifs. I have ridden almost daily through this country at all seasons of the year and think that if they were resident, or bred there, I must have observed them. It is to be hoped that other observers will look out for this species south of the dry zone.

[This bird is evidently the counterpart of, and is in the dry zone of Burma, the representative of *Argya caudata* of the dry area of India. Some ornithologists would therefore no doubt place it as a race of *caudata* since it replaces it geographically. To do so would in my opinion, be quite unsound. *A. caudata* ranges no further east than Western Bengal, and between its range limits and that of *gularis*, there is interposed the very different *Argya longirostris*. *Argya caudata* has never been proved to inhabit Burma; Blyth many years ago recorded it from Thayetmyo and Arakan (Birds of Burma, vol. i, p. 118), and the Arakan record is indicated as based on a specimen from Phayre. It is certain, I think, that a mistake has crept in, as in the Catalogue of the Asiatic Society, Blyth makes no mention of any specimen thence from Phayre.

The only other record is from K. C. Macdonald who records this bird as less common than *earlii* round certain jheels in Myingyan (J.B.N.H.S., xvii, 185). This record cannot be accepted without specimens to substantiate it.—C.B.T.]

228. **Timalia pileata jerdoni** Redcapped Babbler. ♂ ♀ 65, 216, 572.

Common in *kaing* grass jungle in Henzada and probably elsewhere, but it is a great skulker and is more often heard than seen.

232. **Gampsorhynchus r. rufulus** White-headed Shrike Babbler. ♀ 648.

A female was obtained in February in dense evergreen bamboo jungle near Kanazo in the foothills of the Henzada *yoma*.

234. **Pyctorhis sinensis** Yellow-eyed Babbler. 2 ♂ 219, 517.

Seen occasionally in *kaing* grass jungle in Henzada but a great skulker. I saw one feeding young on April 24th.

245. **Pellorneum ruficeps** Spotted Babbler. 1 ♂ 5 ♀ 79, 208, 515, 516, 543, 644.

A great skulker, nearly all I saw being in pairs where there is bamboo in more or less evergreen forest. Seems to spend most of its time hunting about on the ground.

[Birds from the Henzada foothills (100 ft. to 700 ft.) and from Ngapali at sea-level and Leindon, Thayetmyo, I think are all the same. The coloration of the upper part varies; in one from Sandoway it is quite as in the Thayetmyo bird. Two others from Sandoway shot the same day are greyer on the mantle; all have the dark marks at the side of the neck, and blackish marks behind the occiput as in *mandelli*, but have shorter wings and finer and paler breast markings, and the ear-coverts and flanks are paler. The type of *minus* came from Thayetmyo and is a very bad skin. Mr. Kinnear could not of course have seen the above series when (*Ibis* 1929, p. 294) he made *minus* a synonym of *subochraceum*. *Minus* ♂ 69.5-70 mm., ♀ 65.5-69.5 mm. *Mandelli* large series ♂ ♀ 67-74 mm., mostly over 70 mm. The bird referred to as '*ruficeps* subsp.?' from east of the Irrawaddy at Ngaphaw (Prome district) (J.B.N.H.S., xxxiv, p. 671) is quite different again and belongs to the *subochraceum* group, though it does not quite match any others available to me.

In the British Museum birds from Mount Victoria (Chin Hills), Mount Popa (Myingyan), Moiktila and 'Saw-Kawton Road' (?) I consider to be also *minus*. Birds from Mingin and Kani (Upper and Lower Chindwin) appear to be *mandelli*. Birds from Pegu, Rangoon, Toungoo, 'Tapraw', Karenni, 'Taroar' and 'Shan States' are *subochraceum* or a race of it.

The distribution of these birds still requires working out; it seems almost certain that *subochraceum* is a species and not a race of *ruficeps*.]

267. **Malacocincla sepiaria abbotti** Abbott's Babbler. ♂ ♀ 113, 114.

This is also a great skulker and though I believe it to be common in cane-brake and palm-fern jungle a few miles from Rangoon, it is very rarely seen. But for its Thrush-like song, it would rarely be detected. I shot a breeding male which was singing on December 27th, 1931, and on March 26th, 1932, shot a juvenile just out of the nest.

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As the juvenile plumage has not been described, I may record that the legs were pinkish flesh, instead of brownish-flesh colour, and the lower mandible dull yellow instead of grey. The ferruginous on the tail and under-tail coverts is much less pronounced and the crown is streaked with yellow.

The adults crept all round me, churring harshly and occasionally singing, in a dense tangle of palm-fern.

283. **Mixornis r. rubricapilla** YELLOW-BREASTED BABBLER. 2 ♂ 51, 205, 218, 619.

This probably occurs all over the area but is a skulker in bamboo jungle and scrub, and rarely observed. I obtained one in the Pilakat reserve, one in the Henzada foothills and two on the eastern side of the Pegu *yoma*.

[The Henzada bird is a typical *rubricapilla*, and not the race I consider to be *sulphurcus* which Mr. Stanford obtained near Prome.]

290. **Alcippe poioicephala phayrei** ARAKAN QUAKER-BABBLER. ♂ ♀ 610, 611.

Several seen along the Nyaung stream in evergreen jungle and bamboo near Kyibin (Henzada) on February 12th, 1931. One male showed signs of breeding.

[As I have already pointed out (Bull B.O.C., vol. I, p. 84) the acquisition of a small series of this babbler from its type locality, proves that the Assam race is not *phayrei* but must stand as *A. p. fusca*, Godwin Austen (type examined), from Garo Hills in British Museum.—C.B.T.]

362. **Ægithina tiphia** COMMON IORA.

Occurs over the whole area, but is nowhere very common.

368. **Chloropsis aurifrons** GOLD-FRONTED CHLOROPSIS. 3 ♂ 2 ♀ 209, 507, 544-45, 553.

Seems a common forest bird all over the area. I did not observe, or obtain, any of the other species of Chloropsis.

400. **Molpastes cafer burmanicus** BURMESE REDVENTED BULBUL.

Fairly common as far south as Rangoon wherever there is scrub-jungle.

412. **Otocompsa jocosa erythrotis** BURMESE REDWHISKERED BULBUL.

This bird seems to be much commoner in Insein and Henzada than it is in Prome, and is probably the commonest plains bulbul, and found right down to the sea in the Sittang-Elephant Point plain, where I have seen it in the holly scrub in the tidal creeks.

I have seen birds paired on December 8th, and it breeds in bamboo round Rangoon throughout February, being very common in the scrub south of Mingaladon.

413. **Otocompsa f. flaviventris** BLACK-CRESTED YELLOW BULBUL. 2 ♂ 31, 500, 520.

Common and apparently resident at a low altitude in both *yomas*. It is partial to streams bordered by evergreen bamboo jungle. A large flock appeared in my garden at Insein for about an hour on November 9th, 1929, and then moved southwards as if migrating. A single bird seen on the Secretariat in Rangoon on October 31st was also probably a migrant. Armstrong noted that it occurred even on the ships in Rangoon harbour, and Harington found it in the gardens of Rangoon from which, with the spread of building, it has long since disappeared. I have not seen it in the scrub jungle south of Mingaladon where four other species of Bulbuls are common.

[These two birds labelled males have wings of 87 and 87.5 mm. thus reaching the maximum given for the southern race *minor*. Most Pegu birds resemble Indian ones.—C.B.T.]

420. **Iole v. virescens** OLIVE BULBUL. ♀ 604.

Oates considered it a common forest bird in Pegu. The only one seen or obtained by me was one shot on February 11th near Kyibin (in Henzada).

427. **Pycnonotus finlaysoni finlaysoni** FINLAYSON'S STRIPE-THROATED BULBUL.

428. **Pycnonotus finlaysoni davisoni** DAVISON'S STRIPE-THROATED BULBUL. 2 ♂ 1 ♀ 2, 197-98.

Davisoni occurs in the scrub jungle on the laterite ridge between Rangoon and Mingaladon, but it is a great skulker and I have found it difficult to

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observe. This is close to the place where Davison, according to Oates, procured the type, though according to the *Fauna* (i, p. 413) this race was first described by Hume (*Stray Feathers*, iii, p. 301, 1895) from Arakan. I also saw a pair in the old Zepathwe reserve on February 18th close to the sea.

I obtained two *finlaysoni* in similar country on the laterite ridge behind Kawkadut where it was breeding. This is in Thaton district and presumably the Sittang-Rangoon river plain is the boundary between the two races. In this area, I heard several times a song rather like that of an *Acrocephalus* which seemed to be of this bird.

I saw a pair of *davisoni* on November 15th near Rangoon which from their behaviour undoubtedly had a nest or young close by. Several were seen in pairs in January, but after that they seemed to disappear and were rarely seen, though the liquid babbling alarm note was frequently heard in the cane-brake valleys of the scrub near Mingaladon.

In the *Fauna* the iris is described as 'pale to deep brown'. Oates correctly notes it as 'pale yellow' and the iris is most conspicuous in the field, as is a fulvous-yellow line just above the lores.

434. **Pycnonotus plumosus blanfordi** Blanford's Olive Bulbul. ♂ ♀ ♀ 47, 485, 637.

Common and very widely distributed, but not a forest bird. A female obtained on February 14th was about to breed and a nest in bamboo on June 15th contained half-grown young.

439. **Microtarsus melanocephalus** Black-headed Bulbul.

442. **Microtarsus cinereoventris** Grey-bellied Bulbul. 2 ♂ 3 ♀ 3, 4, 10, 46, 64, 498, 499.

Melanocephalus is common in the cane-brake and scrub jungle between Rangoon and Hlawga. On January 1st, 1930 I shot a female *cinereoventris* sitting beside a male *melanocephalus* while the latter was singing to it. I also obtained this bird in the Henzada foothills in company with *Otocompsa flaviventris*. A male *melanocephalus* seen courting on February 16th sat at right angles to the female and bowed repeatedly up and down on a telegraph wire.

492. **Saxicola caprata burmanica** Burmese Stonechat. ♂ ♀ 478, 598.

Common and distributed over the whole area, except in the Sittang paddy-plain where I never saw any. On February 8th most seemed to have paired.

497. **Saxicola torquata stejnegeri** Japanese Bushchat. 582.

Common over the whole area down to the sea from November to April. I noticed on January 30th, 1931, while motoring across the paddy-plain near Danubyu, that males of this species were to be seen every hundred yards along the road for six or seven miles but no females.

498. **Saxicola torquata leucura** White-tailed Bushchat. 3 ♂ 3 ♀ 423-4, 450, 452, 580-1.

Seems common in Prome, Henzada and North Insein but is confined to the riverine area where pea-fields or *kaing* grass occur, exactly the same country as the Striated Marsh Warbler haunts. I have seen birds obviously paired in early January, and young on the wing on May 21st. A male with enlarged gonads was shot on February 3rd.

501. **Oreicola jerdoni** Bushchat. ♂ 596.

I shot one on February 8th, 1931 in *kaing* grass at Leikchaung near Henzada. As Oates thought, it appears to be a bird of 'extreme rarity' in Lower Burma.

520. **Enicurus immaculatus** Black-backed Forktail.

Occurs on the *yoma* streams in Insein and Henzada. I did not collect any.

538. **Cyanosylvia suecica robusta** Chinese Red-spotted Blue-throat. 18, 72, 134, 169.

Seen both in Insein and Henzada. On the great Sittang plain it is a common bird of the open stubble but very shy, and all the view one gets of it is of a dark bird flitting away some distance off. If watched on the ground, its robin-like carriage and eyestripe are noticeable. I have seen birds in the Yandoon Island as late as April 23rd.

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542. **Calliope calliope** Common Ruby-throat. 504.
The only one seen or shot in four years was one obtained by Mr. Henricks in scrub-jungle at Htugyi (Henzada) on January 12th, 1931.

559. **Copsychus s. saularis** Magpie Robin. 496.
Common and occurs right down to the sea in the scrub-jungle along the tidal creeks.

563. **Kittacincla malabarica indica** Shama. 22, 23, 512.
Common in both districts, but a bird of dense bamboo jungle and seldom seen. Eggs were found in April and May.
[There seems no doubt that Burmese and North Indian birds are not the same as birds from South India, as they have considerably shorter tails, ♂ 138-162 mm. against 160-200 in South India. Mr. Baker named this northern bird (*Fauna*, ii, p. 118) *indica* distinguishing it from Malayan birds which he called *macroura*. As he described and named a bird from Bhutan, his name must stand though he did not distinguish the North Indian bird from the southern one; *indica* is not a pure renaming of *malabarica* as Mr. Kloss has suggested (*Ibis* 1931, p. 338).—C.B.T.]

581. **Turdus obscurus** subsp. Dark Thrush. ♂ ♀ 621, 634.
I obtained three solitary birds in scrub-jungle (*a*) near Nyaunggon, Insein district in January 1930; (*b*) on February 13th, 1931 near Kyibin in Henzada; (*c*) on February 14th, a few miles from Kyibin at Legongyi. Of the first only a wing was preserved. One was with pipits and *Motacilla alba* at a pool in a stream and flew silently up into the jungle, and sat there motionless for a long time. The last also, when disturbed flitted away under a bush and remained motionless. The stomach of this bird contained fragments of dead leaves and ants.

587. **Geokichla c. citrina** Orange-headed Ground Thrush.
Not seen, except for a solitary bird on the Thanat stream in Insein in October 1929.

610. **Monticola solitaria affinis** Burmese Blue Rock Thrush. ♂ 600.
Not uncommon in the cold weather and I have seen it in the middle of Rangoon.
[Under the name *affinis* Blyth described from Tenasserim a bird with more or less chestnut on the underparts. Such birds are common in Burma. The Chinese form (*philippensis*) has the underparts, from breast to undertail coverts, chestnut, while *pandoo* has none at all. Between these two extremes, all intergradations are to be met with.—C.B.T.]

614-615. **Myiophoneus temmincki** subsp. Whistling Thrush.
I saw a pair on the Nankatu stream near Kyibin (Henzada) in the *yoma* foothills in February 1931. Otherwise I did not observe this bird in the area and obtained no specimens.

639. **Siphia parva albicilla** Red-breasted Fly-catcher.
Common from September to March over a great part of the area.

659. **Cyornis rubeculoides dialilaema** Salvadori's Blue Fly-catcher. ♂ ♀ 447, 618, 647.
I obtained one in December and two in February in bamboo jungle along the Henzada foothills.

665. **Eumyias thalassina** Verditer Fly-catcher. ♂ ♀ 427, 467.
I shot two in Henzada and did not observe many elsewhere.

674. **Anthipes olivaceus poliogenys** Brook's Fly-catcher. ♀ 647.
I shot one at Kanazo near Chondaung in the Henzada *yoma* on February 16th, 1931. It was not shy and sat near me like a Robin for some time in dense evergreen jungle.

679. **Culicicapa ceylonensis** Grey-headed Fly-catcher.
Fairly common in the cold weather all over the area, and a bird of open woodland.

689. **Tchitrea paradisi** Paradise Fly-catcher.
In view of Oates' statement that this bird 'occurs in large numbers in September and October' in Pegu, I looked out for it, but the only one observed

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was a single female which appeared in my garden in Rangoon on October 17th, 1932.

693. **Hypothymis azurea styani** NORTHERN INDIAN BLACK-NAPED FLY-CATCHER. 52.
Common in the Henzada foothills in February 1931, and also in the cold weather near Insein.

701. **Rhipidura aureola burmanica** WHITE-BROWED FANTAIL FLY-CATCHER. ♀ 539.
Not uncommon, though only one was obtained.

[703.? **Rhipidura albicollis** vel. **javanica?** WHITE-THROATED or JAVA FANTAIL FLY-CATCHER.
I noted one of these species as common in the Zepathwe reserve near the sea, and all I saw in February 1932 were in pairs, or single birds. The supercilium in the field is practically invisible, and the bird in the field looks completely black except for a white line on the throat and the tips of the tail feathers. I regret not having collected any specimens as this bird was very partial to mangrove jungle, in which situation Davison found *R. javanica* in Mergui (B.B., i, 267). It is to be hoped that specimens of the Fantail Fly-catcher occurring on the Hanthawaddy coast will be forthcoming ere long. I assumed at the time they were *albicollis* and was unfortunately unable to return to this area to make certain.]

711. **Lanius colluroides** BURMESE SHRIKE. ♂ 537.
Occurs in winter in Henzada but south of this it is by no means common.

712-713. **Lanius nigriceps** BLACK-HEADED SHRIKE.
Despite Oates' remark that it is resident in Burma and 'far commoner in the rains', I am satisfied that over the greater part of the area dealt with, this large and distinctive bird is now very uncommon. In 1931-1932 I kept a very close watch on the Shrikes and in the huge area covered only saw one, a single bird near the coast at Kamakalok. In ten days in August 1931 at Kalaw, Southern Shan States, I only saw one, where *colluroides* was very common.

720. **Lanius cristatus** BROWN SHRIKE. 2 ♂ 2 ♀ 540, 542, 555, 575.
The common Shrike of Lower Burma from early September to April; its harsh swearing note can be heard all day long in and around Rangoon.

724. **Hemipus p. picatus** BLACK-BACKED PIED SHRIKE. ♂ 603.
Not seen except for a male shot in the Henzada foothills in February which showed signs of breeding.
[Typical *picatus*, which is slightly smaller than *capitalis*.—C.B.T.]

729. **Tephrodornis pondicerianus** COMMON WOOD SHRIKE. 217, 552, 627.
Apart from a single bird shot on the eastern side of the Pegu *yomas* at Dodan on 10th May, 1932, few Wood Shrikes were observed over the greater part of the area, but I obtained males about to breed on January 23rd and February 13th in Henzada.

734. **Pericrocotus speciosus fraterculus** BURMESE SCARLET MINIVET. ♀ 622.
I collected very few minivets and found them difficult to distinguish in the field. The only one shot of this species was accompanying a travelling flock of Velvet-fronted Nuthatches and other birds.

744. **Pericrocotus r. roseus** ROSY MINIVET. 446.
I shot one out of a large flock at Inbin (Henzada) in December 1930, the only ones identified for certain.

746. **Pericrocotus peregrinus vividus** BURMESE SMALL MINIVET. 13, 14, 27.
This was the common Minivet of the woodland west of Elephant Point, nearly all being seen in the 'Kambala' trees. Armstrong noted its abundance along the coast.

754. **Lalage melaschista avensis** PALE GREY CUCKOO SHRIKE. ♂ 115, 548.
Only odd birds seen both in Insein and Henzada, one of which in very worn plumage was shot at Kyetpyugan on March 25th.

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758. **Graucalus macei siamensis** Siamese Large Cuckoo Shrike. ♂ 517.
A forest bird and very local in Henzada and Insein. Partial to teak jungle.

763. **Artamus f. fuscus** Ashy Swallow Shrike. ♂ ♀ 433, 588.
Only seen in small numbers except at Inbin on December 27th when a large flight appeared at dusk and disappeared into a leafy tree to roost.
[There seems to be very little variation in this species. Birds from North India, Madras and Burma are indistinguishable.—C.B.T.]

767-769. **Dicrurus macrocercus** Black Drongo. ♂♂ 434, 569.
In the cold weather this bird gathers at night in amazing numbers to roost in bamboo near Rangoon. Until 1931 I was under the impression—as apparently was Oates—that it was 'either absent or very rare' in Lower Burma after March ('January to October', Oates) and in his day it was apparently not known to breed.
A number of pairs undoubtedly bred in tamarind, gold mohur and other trees near Henzada in 1931. I saw a bird sitting in May, and on May 30th two young drongos just out of the nest. Another nest was high up in a huge tree in my garden. All these birds seemed to be extraordinarily silent and self-effacing at this time of year, and a close watch had to be kept to find them at all.
In 1932 I noticed Drongos near Rangoon till late May 1932 after which they disappeared, and breeding pairs were seen in the Yandoon Island in late April. I also saw pairs I suspected to be breeding on the Thanatpin-Kamase Road in Pegu in April. This bird's status in Lower Burma needs working out.

771. **Dicrurus leucophaeus** subsp.? Grey Drongo.
773. Drongo. 12, 13, 17, 69, 519, 620.
I obtained a few specimens of this puzzling species both in Henzada and Insein, but not enough to throw any light on the distribution of the races, nor did I see any breeding. I got the impression that the same bird in different lights presented considerable apparent variation in colouring, most as far as I could see being of the pale variety, though some seen in the grounds of the Rangoon University at close range in early November had very dark cheeks, wings and back, with the pale breast noticeable by contrast.
A further large series is necessary to determine the race.

780. **Chaptia aenea aenea** Northern Bronzed Drongo.
This is a forest bird and occurs in the foothills of the *yomas* on both sides.
[The Bronzed Drongo is one of those species which exhibits a smaller race at the end of the arc South India-Malaya. Pegu birds are nearer the typical race (wing up to 126 mm.), than to *malayensis* but are slightly intermediate as one might expect.—C.B.T.]

782. **Chibia h. hottentotta** Indian Hair-crested Drongo. 612, 617.
Occurs all along the Henzada *yoma* from Tonbo in Prome southwards. It seems to be a forest bird and I saw few near Rangoon, but a party of five which were seen in the University Estate on November 5th were probably migrants.
[The long hairs on the head of this bird do not spring from the posterior part of the crown, as has been stated, but from the forehead. The first year bird has less glossy tail and wings, and less curled outer tail feathers, as well as shorter frontal hairs than adults. 5 ♂ wing 161-168 mm.—C.B.T.]

788. **Dissemurus paradiseus rangoonensis** Burmese Large Racket-tailed Drongo. 116.
Common throughout the area wherever there is fairly dense woodland and is still seen in and near Rangoon. It struck me as being very abundant on the western edge of the Pegu *yoma*.

797. **Acrocephalus arundinaceus orientalis** Eastern Great Reed Warbler. 2 ♂♂ 23, 129, 173, 528.
I obtained one skulking in *kaing* grass in Henzada on January 18th and each small tank on the Sittang Plain held one or two of these birds throughout the open season. One was shot while singing, and I heard others, in

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bushes far out on the plain of the Yandoon Island, at the end of April 1932. Possibly they breed here in the rains.

[*Locustella*? I frequently flushed undoubted Grasshopper Warblers in the Sittang Plain, especially out of the tufts of tall grass growing between the paddy-fields, but they rarely offered one a chance to shoot and would dive into the undergrowth at one's feet and disappear like a mouse.]

814. **Orthotomus sutorius patia** BURMESE TAILOR BIRD. 56.

Common and breeds in the gardens of Rangoon, but I only collected one specimen.

825. **Cisticola juncidis malayana** STREAKED FANTAIL WARBLER. 2 ♂ 2 ♀ 468, 469, 480, 530.

Seems fairly common.

827. **Franklinia gracilis** FRANKLIN'S WREN WARBLER. ♂♂ 206, 207.

The only ones seen for certain were males obtained—apparently about to breed—in paddy-cultivation on the edge of forestland in Pegu—east of the *yoma*—on May 10th.

828. **Franklinia r. rufescens** BEAVAN'S WREN WARBLER. ♂♂ 653, 654.

Mr. Henricks obtained two males near Legongyi on the edge of the Henzada *yoma* on February 17th.

836. **Megalurus palustris** STRIATED MARSH WARBLER. 2 ♂ 1 ♀ 477, 577, 663.

Extremely common in the Irrawaddy-Sittang Plain wherever peafields, or rough grass and cane-grass occur along streams. Individuals were in full song on December 8th.

839. **Phragmaticola aedon** THICK-BILLED WARBLER. 2 ♂ 2 ♀ 491, 535-36, 549.

A number were shot in Henzada in January and February, mostly in bushes near water.

852. **Phylloscopus affinis** TICKELL'S WILLOW WARBLER. 177.

I shot a single bird in tamarind scrub near Prome on 17th February, 1929.

860. **Phylloscopus fuscatus** DUSKY WILLOW WARBLER. 5 ♂ 2 ♀ 16, 174, 176, 493, 494, 495, 518, 564, 565.

I obtained three in Prome in 1929 and most of those seen in Henzada were of this species. They were usually in scrub jungle near pools, but two were in peas and high grass and in this situation, with their low 'chuck'-ing note and skulking movements, looked much like *Acrocephali*. It was also common in the Zepathwe reserve near the sea, and along the coast.

[In a series of this warbler one can see differences in the colouration of the upper parts, some being browner, others greyer. This difference may possibly be due to age and it would not be safe to recognise any races on birds in their winter quarters. I have seen no specimens of *homeyeri* nor of *altaicus*.—C.B.T.]

876. **Phylloscopus nitidus plumbeitarsus** MIDDENDORFF'S WILLOW WARBLER. 502.

Mr. Henricks obtained one on January 12th at Htugyi in Henzada.

943. **Prinia inornata blanfordi** TENASSERIM WREN-WARBLER. 2 ♂ 2 ♀ 225, 470-74, 523, 562-63.

Common, usually in grassland near water, but occasionally in bush jungle in quite waterless grazing grounds.

[I do not think that *burmanica* (type locality Mandalay) is a recognisable race. The type and two others from that locality were obtained in June and are in somewhat worn breeding dress. There are also available birds in similar dress from Maymyo in August. This series does not differ in colouration from a series of Pegu birds obtained in July. It is said that *blanfordi* (type locality Toungoo) never attains a black bill in the breeding season, and possibly this is quite correct, but, although the type of *burmanica* has a black bill, none of the rest of the series has, so his distinction falls to the ground also.

Winter birds from Mandalay district are badly needed. 4 males from Henzada: wing 50.5-53 mm., tail 69-76 mm. (winter). 2 females from Henzada: wing 46.5-50, tail 63-66 mm. (winter).—C.B.T.]

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950-51. **Irena puella** subsp. FAIRY BLUE BIRD.
Not seen apart from one or two in the Henzada *yomas* at about 1,000 ft.

955. **Oriolus chinensis tenuirostris** BURMESE BLACK-NAPED ORIOLE. ♂ 556.
Few Orioles were collected. This was the only one shot in Henzada and seemed to be the common Oriole round Rangoon.

964. **Eulabes religiosa** subsp. INDIAN GRACKLE.
Not uncommon in the *yomas* on both sides but I have never seen it in the plains. A forest bird.

972. **Psaroglossa spiloptera** SPOTTED-WINGED STARE. ♂♂ 601, 602.
The only ones seen were a large flock on a *Bombax* tree near Kwingauk (Henzada), on February 11th. This flock presented a remarkably beautiful appearance, as each bird was sitting, in a curiously upright posture, on the top of a tree, with the chestnut throat gleaming in the sun.
This is a bird only occasionally seen, and its movements are all too little known. Oates never met it.
[This bird is very variable in the male plumage. The type of *assamensis* from the Khasia Hills is an exceptionally deep-coloured bird and there are very few like it in the British Museum. From Assam, however, there are a great many birds which are not different from Western Himalayan birds, and, therefore, I cannot recognise *assamensis* as a tenable race.—C.B.T.]

987. **Sturnia malabarica nemoricola** GREY-HEADED MYNAH. ♂♂ 522, 568.
Mostly seen from October to April but certainly breeds in Insein. It is very partial to feeding on the branches of mango-trees.
[This race varies very much in the colouration of the underparts and, no doubt, pink-breasted birds, such as one of these males from Henzada with black primary coverts, have given rise to the old records of *malabarica* in Burma. This bird is not distinguished from females of *malabarica* but is paler than any male of that race.—C.B.T.]

996. **Acridotheres t. tristis** COMMON MYNAH.
Very common and resident. It is the only bird I know which habitually walks about *singing* while looking for its food.

999. **Æthiopsar fuscus** subsp.? JUNGLE MYNAH.
A common bird all over the area, and even in outer Rangoon; I have seen very large gatherings at roosting time at the Tadagale sewage farm, and in *kaing* grass and bushes near Henzada.

1007. **Sturnopastor contra superciliaris** BURMESE PIED MYNAH. ♀ 558.
Common and resident.

1011. **Ploceus infortunatus burmanicus = passerinus** auct. EASTERN BAYA. ♂ 429.
I did not collect any breeding Bayas. A non-breeding bird shot at Kyangin (Henzada) in December was the only one obtained.
[This, unlike those collected by Mr. Stanford at Ngaphaw, Prome District, undoubtedly belong to this species and not to *philippinus*. As I have already pointed out, the name *passerinus*, which has been used for this weaver, as well as *atrigula* and *baya*, are synonyms of *philippinus*.—C.B.T.]

1015. **Ploceus manyar** STRIATED WEAVER BIRD.
I saw a few but did not collect any, and am unable to define the bird's status in the area.

1016. **Ploceella chrysaea** GOLDEN WEAVER BIRD. 579.
Common. I saw a colony breeding on toddy palms in Henzada on June 12th and another colony of nests in a small acacia tree in the Rangoon Turf Club stables quite regardless of the constant disturbance of horses and men within a few feet of them. In Prome it breeds in reed beds with *Ploceus infortunatus*.

1020. **Munia atricapilla rubronigra** NORTHERN CHESTNUT-BELLIED MUNIA. ♂ 488.
Common. In Henzada it was still in flocks in mid-June but I found many nests in the third week of July. In Insein I have seen birds building

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as late as November 1st. Bushes or *kaing* grass clumps close to water are the favourite situations.

[Typical Nepal birds (*rubronigra*) have the belly and undertail coverts black, whereas Malay examples (*atricapilla*) have these parts sullied chestnut. Nepal birds are larger, wing 55-56 mm., against 52-53 mm. in Malay birds. A series from Pegu measures 52-56 mm. and not only do they show the extreme measurements of both races but every intergradation in the colour of the underparts. They are in fact, exact intermediates between the two races.

1025. **Uroloncha striata subsquamicollis** WHITE-BACKED MUNIA. 4 ♀ 629, 632.

In Henzada it is either rare or very local and was not seen elsewhere. I shot four out of a flock near Kyibin feeding on seeds of *Cephalostachyum pergracile*. Later, on May 2nd, I saw a pair building in a bush in the bazaar quarter of Henzada town and on May 22nd another pair was collecting nesting material in my garden. This struck me as unusual, as this munia is normally a forest munia and very rarely seen elsewhere.

[I leave these for the present as *subsquamicollis* pending revision of the group.]

1032. **Uroloncha punctulata subundulata** BURMESE SPOTTED MUNIA. ♂ ♀ 425, 426.

Common, and breeds on houses even in Rangoon. I have seen pairs building in late November when most Munias were in flocks and have also seen flocks as late as mid-June.

[This very difficult species of munia wants revising. In the meantime I leave these Burmese birds under the name given to the Assam race. Baker recognised this race in the *Fauna* (iii, 92) but in the synonymy (vii, 223) it is sunk as a synonym of *punctulata*.—C.B.T.]

1037. **Amandava a. flavidiventris** BURMESE RED MUNIA. 3 ♂ 463-4-5, 599.

Common and winters. Seen in flocks up to mid-June. A bird of *kaing* grass.

[I certainly should regard this bird as a race of the Indian Red Munia. Outside India there are such obvious gaps in the distribution of *A. amandava* that it seems certain that where it occurs, it must have been introduced.—C.B.T.]

1097. **Passer domesticus nigricollis** BURMESE HOUSE SPARROW. ♂ ♀ 437, 438.

Those obtained were from a breeding colony at Inbin (Henzada) in December. This sparrow is very local all over the area, *montanus* taking its place as a house-sparrow, and in Henzada it is more often seen round fishing huts and near the river where, I suspect, it nests in the holes made by Sand Martins. I have seen both *domesticus* and *montanus* in large flocks in mid-June.

1102. **Passer montanus malaccensis** INDIAN TREE SPARROW. 6.

This is the true house-sparrow throughout the area and far more abundant and less shy than *domesticus*. It seems to nest at all seasons, but mainly from August to November. Harington's description of it as 'partially migratory, disappearing in the middle of the rains and returning in November' is not now true of the Rangoon district.

1108. **Passer flaveolus** PEGU HOUSE-SPARROW. 3 ♂ 1 ♀ 449, 492, 559, 560.

Common in Henzada and winters. Breeds in bungalows in company with *montanus*. Not common in Insein.

1120-1. **Emberiza fucata** subsp. GREY-HEADED BUNTING. 1 ♂ 4 ♀ 66-68, 133, 177.

I saw one in Henzada on April 26th with a flock of *aureola* and found it common in the Sittang-China Bakir plain. It is a shy bird of the stubble and easily overlooked, unless specially searched for, but in the Yandoon Island, where water is scarce, it is very familiar and comes close up to the cultivators' field huts. In April, besides the chestnut cheek-patch, the chestnut scapulars are very noticeable in the field.

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1131. **Emberiza aureola** YELLOW-BREASTED BUNTING. 3 ♂ 2 ♀ 171, 191, 428, 479, 660.

Very common from October to early May. Roosts in very large numbers in the bushes fringing streams. In late April many old males are completely black about the lores and cheeks and the pectoral band is very pronounced, but the rest show great individual variation.

1148. **Riparia paludicola chinensis** INDIAN SAND MARTIN. ♂♀ 489, 591.

I have never so far been able to detect *ijimae*. Many are breeding by November, but I have shot non-breeding females in January. It is apparently resident as I have seen large flocks in June and July.

The young of this bird when on the wing, appear to show a good deal of white on the rump, due to the pale edges of the feathers.

1153. **Hirundo rustica gutturalis** EASTERN SWALLOW. 4 ♀ 117-18, 201, 557.

1154. **Hirundo rustica tytleri** TYTLER'S SWALLOW.

Local name: Pyan-hlwa.

As Oates did, I have noticed individuals of *gutturalis* almost throughout the year, except possibly from June 1st to July 15th. I have seen a good many *tytleri* both in November and April with rich chestnut flanks and belly, but failed to obtain any in Lower Burma.

1159-63. **Hirundo daurica** subsp. STRIATED SWALLOW. 2 ♂ 1 ♀ 457-8-9.

Very common in the cold weather and a jheel-haunting bird, in Lower Burma, which does not appear to breed. I have seen individuals in mid-July.

(I kept a close lookout for *H. smithii* which was obtained near Rangoon in Oates' day, and recorded by Harington, but failed to detect it.)

1170. **Motacilla alba ocularis** STREAK-EYED WAGTAIL. ♂ 184.

I shot one near Yandoon (Maübin) on April 25.

1173. **Motacilla alba leucopsis** WHITE WAGTAIL. 1 ♂ 3 ♀ 484, 497, 649, 650.

All obtained in Henzada were of this race and it is common until about mid-March.

1176. **Motacilla flava simillima** GREY-HEADED WAGTAIL. 8 ♂ 7 ♀ 134, 174-5-6, 182, 186-7-8, 200, 210, 451-3, 521, 660, 662.

All obtained in Henzada were of this race, and occurred up to early May. In the hot weather of 1932 I obtained a further series in April and May in Yandoon (Maübin), Kyaikto (Thaton) and in parts of the Pegu division, two of which from Maübin were identified as *macronyx*. The majority, after very careful observation with powerful glasses at short range, were noted as having 'dark greyish head and nape, lores, cheeks and ear-coverts almost black, throat and breast bright yellow, tail very dark. A few birds with paler heads have a faint streak behind the eye.' A male in very fresh plumage (175) had the tip of the chin pure white and a pure white patch behind the gape. There is no doubt that none of the full plumaged males in the field seem to show any trace of a supercilium which is supposed in the *Fauna* to be characteristic of *flava*. In Lower Burma, the Yellow Wagtail is not a water-hunting bird: the great majority feed on the dry grassy uplands or far out on the paddy plain. In Maübin they follow the plough. On April 24th I saw many large flocks flighting to roost in Yandoon.

[These birds are of the same type of *flava* as were in the Prome collection and which, for the present, I keep as *simillima*. They resemble *thunbergi* but have slightly longer bills. The supercilium is absent in some and slightly indicated in others. This may be pure individual variation.—C.B.T.]

1174. **Motacilla cinerea caspica** EASTERN GREY WAGTAIL.

Common from late September to March and I have frequently seen birds feeding on laterite roads far from water.

1181. **Motacilla c. citreola** YELLOW-HEADED WAGTAIL. ♂♀♀ 182, 183, 430.

This is the real water-wagtail, being a bird of jheels and rivers, and rarely seen far from water. It occurs all over the area and I have twice seen large numbers on the Irrawaddy flocking at roosting time, once as late as April 25th.

1182. **Dendronanthus indicus** FOREST WAGTAIL.

By no means uncommon, even in the 'Suburban Development' area near Rangoon, where Harington describes it as a rare winter visitor. I have only

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noticed it from October to March and saw it in bamboo jungle, dry deciduous jungle in the Henzada *yomas*, and in mango clumps. It has a faint single note which is difficult to locate, and when flushed flies into a tree and much resembles a Tree Pipit.

1186. **Anthus hodgsoni** subsp. TREE PIPIT.
A winter visitor and nearly always found in the shade of tamarind trees, though occasionally seen in bamboo. Leaves in early April.

1193. **Anthus r. richardi** RICHARD'S PIPIT.
Common all over the area. In the hot weather when motoring at mid-day along a road through the Sittang Plain, where small trees have been planted at regular intervals, I noticed single Pipits sitting in the shade of each tree for a distance of three or four miles.
In 1931 some remained until the first week in May.

1195. **Anthus richardi rufinus** INDIAN PIPIT. 2 ♂ 4 ♀ 431, 471, 473, 483, 659.
Very common. A male shot on February 18th had enlarged gonads and I found a sitting bird in mid-April.

1199. **Anthus cervinus** RED-THROATED PIPIT. ♀ 33, 59, 124-5, 222.
In Henzada a bird of the *kaing*-cultivation and partial to water, but out in the great Sittang paddy-plain in March and April, frequently seen in large flocks on burnt stubble, the immense number in the area only being realised when one sees the constant stream of birds coming to drink at the scattered tanks. I saw birds assuming spring plumage as early as February 10th and it occurs up to the fourth week in April on the stubble.

1215. **Alauda g. gulgula** INDIAN SKYLARK. ♂♂♀ 121, 122, 481, 482.
Noted as singing in December and a young bird just out of the nest was obtained on January 7th. Two breeding males with enlarged gonads were shot in the Sittang Plain on April 1st. These birds seem to prefer the wide expanses of 'dhoob' grass and the peafields to the stubble; I saw flocks in mid-August near Rangoon which were probably immigrants.
[These birds are a richer creamy brown below and darker above than most *gulgula* and have more buff on the tail. Winter birds from Pegu in the British Museum I cannot differentiate from *gulgula*.—C.B.T.]

1225. **Calandrella r. raytal** GANGES SAND LARK. 3 ♂ 2 ♀ 455-56, 584-85, 589.
Though Oates thought it did not occur South of Prome, I found it abundant right through the Prome and Henzada districts and down the Irrawaddy as far south as the Yandoon Island. So little of the island land survives at the height of the rains that it would be interesting to know if this bird performs a local migration then.
I have heard it singing in early December and saw many paired on December 26th but they apparently do not start breeding before mid-February.
[These are quite indistinguishable from birds from the Ganges. 3 males: wing 82 mm.; 2 females: wing 75 mm.—C.B.T.]

1253. **Zosterops siamensis** SIAMESE WHITE-EYE. 29.
I saw several large parties in the Zepathwe reserve near the sea in mid-February 1932 and did not observe it otherwise.

1257. **Chalcoparia singalensis** RUBY CHEEK.
I saw a single male near Henzada in July 1931.

1279. **Cinnyris asiatica intermedia** BURMESE PURPLE SUNBIRD. 3♂♀ 445, 513, 614, 656.
Several were obtained along the foot of the Henzada *yomas* from December to February.

1284. **Cinnyris f. flammaxillaris** YELLOW-BREASTED SUNBIRD. ♂ 486, 645.
Two obtained in Henzada at Ingabu and Legongyi.
[The difference in the amount of white in the tail, between this Sunbird and *asiatica*, in the females is not distinct, and in the absence of paired females of *flammaxillaris* I can give no certain distinctions for separating the two.—C.B.T.]

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1345. **Picus canus hessei** BURMESE BLACK-NAPED GREEN WOODPECKER. ♀ 508.

I shot a female which was with a flock of Laughing Thrushes at Kywezin in the Henzada *yoma* on January 13th. (wing 155 mm.)

[Wing 155 mm. *Glydenstolpei* (Assam) ♂ wing 140-146 mm.; *hessei* (North Siam) ♂ wing 142-154 mm. This specimen in colour also is nearest to *hessei* but the two races intergrade.—C.B.T.]

1346-8. **Picus chlorolophus** SMALL YELLOW-NAPED WOODPECKER.

I saw individuals in the *yoma* foothills of Henzada and Insein but collected none.

1372. **Dryobates analis longipennis** SPOTTED-BREASTED PIED WOODPECKER. ♂ ♀ 533, 550.

Two were obtained on the northern border of the Henzada district in January 1931. They are small, shy and difficult to observe.

[Wing 97 mm. *D. analis* (Java) measure mostly ♂ 92-96 mm. and *longipennis* (Siam, Bangkok) mostly 98-102 mm. Burmese birds correspond fairly well with Siamese birds in being on the whole longer than Javan birds. The spotting on the breast seems variable in both races and good skins are needed to see any constant difference. Single birds from Burma (Thayetmyo) are no longer than Javanese birds (wing 92-94 mm.) while a female from Karenni measures 105 mm. I think *longipennis* should be recognised though it is not a very well defined race.—C.B.T.]

1379. **Dryobtes nanus canicapillus** BURMESE PIGMY WOODPECKER. ♂ ♀ 607, 608.

I shot a breeding pair in February 12th in *indaing* jungle near Kyibin (Henzada). This bird's small size, weak flight, and rudimentary crest made me think both were juveniles.

1389. **Micropternus brachyurus phaioceps** BURMESE RUFOUS WOODPECKER. ♂ 443.

I shot one of a pair seen at Inbin (Henzada) in teak trees in January 1931 (wing 127 mm.).

1399. **Dinopicus javanensis intermedia** GOLDEN-BACKED THREE-TOED WOODPECKER. 1 ♂ 2 ♀ 443, 633-39.

I obtained three at Inbin and Legon in the foothills of Henzada in January and February, which showed no signs of breeding.

[These types are practically topotypes.—C.B.T.]

1404. **Chrysocolaptes g. guttacristatus** TICKELL'S GOLDEN-BACKED WOODPECKER. ♀ 616.

Fairly common both in Insein and Henzada.

[Wing 162 mm.—C.B.T.]

1424. **Iynx torquilla japonica** JAPANESE WRYNECK. ♂ 448.

Occasionally seen in winter both in Henzada and Insein, in all sorts of places.

[Wing 87 mm. This and other Wrynecks from Burma in winter are on the whole more ochraceous on the underparts than European birds and in this respect they resemble *japonica*. The latter are, however, smaller and have the upper parts and wings darker and more rusty in colouration, whereas the Burmese birds are like *torquilla* on these parts.—C.B.T.]

1433. **Thereiceryx lineatus intermedius** BURMESE LINEATED BARBET. ♀ 641.

Common in both *yomas*, but a forest, and not a garden bird, as it is in Northern Burma; I saw a large gathering in Henzada on a *Ficus* tree in mid-February.

1436. **Cyanops a. asiatica** BLUE-THROATED BARBET. ♂ 643.

I shot one of a pair feeding on *Dillenia pulcherrima* seeds at Chondaung in the Henzada *yoma* foothills on February 16th, 1931, the only ones seen by me. Oates appears to have no records from the western part of Pegu or the delta, but this bird was exceedingly common in the Prome *yomas* on the Arakan side and probably extends down through Henzada.

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1446. **Xantholaema haemacephala indica** BURMESE CRIMSON-BREASTED BARBET. ♀ 487.
Common all over the area, and a bird of gardens, fields and open country.

1463. **Cacomantis merulinus querulus** BURMESE PLAINTIVE CUCKOO. 2 ♂ 2 ♀ 7, 35, 460, 546, 547.
Common throughout the area and (except in the breeding season, when I have seen it in dry scrub jungle, a bird of marshland and jheel sides. This bird is far from shy, and the only Cuckoo which gives one a good opportunity to watch it in the field.
[By a slip, two birds obtained by Mr. Stanford in Prome were listed under *Cacomantis sonneratii*.—*J.B.N.H.S.*, xxxv, p. 33.—C.B.T.]

1474. **Clamator coromandus** RED-WINGED CRESTED CUCKOO.
Several times seen in September, October and November, apparently on passage in Insein. I never observed it at any other time.

1475-76. **Eudynamis scolopaceus** subsp.? KOEL.
Common, and widely distributed. The only young one seen by me was on May 4th, being fed by *Corvus insolens*.

1480. **Rhopodytes tristis** LARGE GREEN-BILLED MALKOHA.

1491. **Centropus sinensis intermedius** HUME'S CROW PHEASANT.

1495. **Centropus b. benghalensis** LESSER CROW PHEASANT.
These three birds all occur in the area, Hume's Crow Pheasant being common and the others rarely seen.

PSITTACULIDAE.

The region of the foothills west of the railway in Henzada district was the only place where I had any opportunity to collect these birds, and it was curious that at each place, only one species was collected and the others were not seen at all.

1501. **Psittacula krameri borealis** EASTERN ROSE-RINGED PAROQUET.
I saw a few at various places in Henzada but it was not common.

1503. **Psittacula cyanocephala benghalensis** BLOSSOM-HEADED PAROQUET. 2 ♂ 1 ♀ 439, 440, 441.
Common at Inbin (Henzada) in late December 1930 and a pair seen courting.

1505. **Psittacula schisticeps finschi** BURMESE SLATY-HEADED PAROQUET. 2 ♂ 506, 509.
Great numbers in flocks near Kywezin (Henzada) in mid-January 1931, and probably the commonest Paroquet in Henzada. I watched some feeding on the seeds of *Dendrocalamus longispathus*.

1508. **Psittacula alexandri fasciata** RED-BREASTED PAROQUET. 1 ♂ 2 ♀ 615, 636, 642.
Abundant down the *yoma* edge from Kyibin to Legon in mid-February 1931, in pairs and flocks and about to breed. Many were feeding on flowering *Bombax*.

1513. **Coryllis v. vernalis** INDIAN LORIQUET.
Seen both in Insein and Henzada, but it is one of the small silent unobtrusive birds which is easy to overlook, and whose status is hard to determine. I have watched them feeding in a small tree on a village road, taking no notice of the people passing beneath.

1519. **Coracias benghalensis affinis** BURMESE ROLLER.
For much of the year, this bird appears to be entirely solitary and one rarely sees more than one at a time. At certain seasons, considerable numbers can be seen together, e.g. on January 14th I watched a large gathering fighting together among teak trees where they probably intended to breed. Again on November 22nd I saw a large number on a grazing ground near Insein, the males displaying and chasing each other and taking long flights to and fro.
In the rains, only a few single individuals can be seen.

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1524. **Merops orientalis birmanus** Burmese Green Bee-eater. 3 ♂ 1 ♀ 592, 593.

Common throughout the area, breeding from February onwards. I saw fledged young on May 2nd. In the sea coast area a large number breed in holes out on the flat open dunes above the normal tide-mark. I found Bee-eaters nesting in similar country in the Sunderbunds of the Khulna district, (Bengal).

A certain number remain throughout the rains but it is certainly not nearly so common.

1526. **Merops superciliosus javanicus** Blue-tailed Bee-eater.

In Henzada and Insein this bird breeds all over the cultivated *kaing* land, in small holes in the pea-fields, in banks and the sides of earthen wells. On the sea coast on February 21st, I found a number of birds just commencing to breed on the open flat sand dunes behind the beach. (A party seen flying North on February 18th were probably on migration.)

Some undoubtedly winter on the Henzada jheels and the Hlawga lakes, but though it is then very local and easy to overlook, I believe the majority migrate, and migrants appeared in my garden on October 16th.

1528. **Melittophagus e. erythrocephalus** Chestnut-headed Bee-eater.

I saw pairs in forest land in Henzada and Insein and a pair in the Zepathwe reserve on February 19th. It is a shy bird and easy to overlook. I think some undoubtedly winter on the Hlawga lakes but Armstrong thought it a migrant, appearing in February.

1529. **Bucia atherioni** Blue-bearded Bee-eater.

I saw a single bird at an elevation of about 800 ft. in the foothills near Kongyi (Henzada) in April 1931. It probably extends along the foothills of both *yomas* wherever there is evergreen forest.

1531. **Ceryle rudis leucomelanura** Indian Pied Kingfisher. 475, 476.

Common, a bird of the jheels and the shallows of the larger rivers. Mr. Henricks obtained two young ones just out of the nest on January 7th in Henzada.

1533. **Alcedo atthis benghalensis** Common Indian Kingfisher. 26.

Common and widely distributed down to the neighbourhood of the sea where a few occur in tidal waters in the Zepathwe reserve.

1540. **Alcedo meninting** subsp. Blue-eared Kingfisher.

I am quite sure that I saw this Kingfisher near Kyachaung on the western side of the Pegu *yoma* in Insein district in October 1929. I did not obtain any, but the birds were common in dense bamboo jungle and their very brilliant colouring was most noticeable. At that time of year I expect they feed largely on insects.

1544. **Ceyx tridactylus** Indian Three-toed Kingfisher.

I saw a single bird in April 1931 at a low altitude in the Henzada foothills and one was shown me as having been obtained in the grounds of the old Rangoon College near the 'Old Maidan'. It is a shy species, fond of bamboo jungle and easy to overlook.

1549. **Ramphalcyon capensis** Stork-billed Kingfisher.

Fairly common and widely distributed. Occasionally occurs on the Rangoon Lakes.

1551. **Halcyon smyrnensis fusca** White-breasted Kingfisher.

Common all over the area, occurring even in the gardens of Rangoon, and far out on the tidal mud of the sea coast.

1554. **Halcyon pileata** Black-capped Kingfisher. 24, 25.

Apart from one seen by Mr. Henricks on February 10th, 1931, on the Kwingauk stream in the Henzada foothills, this bird is confined to tidal water and was rightly considered by Armstrong to be the most 'markedly characteristic' bird of the Rangoon river coast line. Here it is extremely abundant, not only alongshore, where it feeds on crabs, but inland as well in the willow and mangrove jungle, where it is not at all shy. It occurs up to Rangoon and Insein along the tidal creeks, and I once saw one on the Rangoon Lakes. In the tidal area, I saw no banks suitable for nesting holes and possibly it breeds in ants' nests.

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1557. **Sauropatis ch. chloris** WHITE-COLLARED KINGFISHER. ♂ 58.
Armstrong obtained four in the Rangoon River delta and considered it rare. I saw four or five in the forest area west of the Rangoon river, in *Sonneratia* jungle along tidal streams, and once in very dry open scrub jungle with an undergrowth of what Burmans call 'sea-sessamum', where a pair were apparently insect-hunting. The flight is curiously hesitant and weak and they look more like a Cuckoo-Shrike than a Kingfisher in flight. One out of a pair uttered a cry like a Wryneck. They were not at all shy and are probably confined to forest country in tidal limits.

1566. **Anthracoceros malabaricus** BURMESE PIED HORNBILL.
Harington records both this and *Dichoceros bicornis* from Taukkyan, whence the heavy jungle has long since disappeared. I have seen *Anthracoceros* in both the Henzada and Pegu *yomas*.

1583. **Upupa epops longirostris** BURMESE HOOPOE. ♂ 638.
I think this bird probably performs a local migration to the foothills and more wooded parts of the country to breed. In 1929 the first birds noticed were on October 10th and from then on it is common till February. I saw birds paired and about to breed in the Henzada foothills in mid-February and in the same year saw young just able to fly, near Kalaw (S.S.S.) in early August.

1586. **Harpactes e. erythrocephalus** RED-HEADED TROGON. ♂ 646.
Occurs in some numbers in the foothills in both *yomas*.

1593. **Micropus p. pacificus** LARGE WHITE-RUMPED SWIFT. ♀ 609.
I shot two out of a large flock hawking over *indaing* jungle near Kyibin (Henzada) on February 12th, 1931, the only ones seen for certain.
[This specimen belongs to the typical race; *cooki* from the Shan States has much coarser streaks on the throat and rump. As regards the general colouration of the upper parts, season evidently makes a good deal of difference, for *pacificus* from Siberia in May is more different from *pacificus* from Australia in winter than the latter is to *cooki* in May.—C.B.T.]

1599. **Micropus affinis subfurcatus** MALAY HOUSE SWIFT.
Breeds in the High Court and Secretariat at Rangoon from June up to early October. I have seen parties in Rangoon in mid-December but the bird is usually not noticeable except in the rains. It is noteworthy that Oates found a pair of Swifts nesting at Wanetkon on the Rangoon-Pegu Road in January.

1602. **Tachornis batassiensis infumatus** EASTERN PALM-SWIFT.
Occurs throughout the area, breeding in toddy and cocoanut palms where they occur. I have not noticed it breeding in the roofs of thatched huts as it does in Northern Burma.

1616. **Hemiprocne coronata** INDIAN CRESTED-SWIFT.
A very local bird. Nearly all I have seen have been in places where girdled, or dead, teak-trees occur in fairly open country. This type of country is common in the northern part of Henzada and in places in Insein.

1629. **Caprimulgus monticalus** FRANKLIN'S NIGHTJAR. ♂ 606.
I shot one and saw others on February 11th, 1931, in the Henzada *yoma* foothills. The male shot uttered a curious loud single note unlike a nightjar. It is noteworthy that all the occurrences noted by Oates are from Eastern Burma, roughly Toungoo to the Thaungyin valley and that neither Harington, Mackenzie or Wickham apparently met with this Nightjar.

1630. **Caprimulgus asiaticus** COMMON INDIAN NIGHTJAR. ♀♀ 657, 658.
On the flood embankments of Insein, numbers could be seen sitting after dark, their eyes gleaming redly from a distance in the lights of a motor. Those obtained were accidentally killed by me in this way and in Insein I once killed three with my car during an early morning drive. These birds spend the day in the bushes near the embankments and have probably left to breed in March, as far as I have observed.

1631. **Lyncornis cerviniceps** GREAT-EARED NIGHTJAR.
I saw a gathering at Kyachaung in the Insein *yomas* on October 22nd, 1929; at dusk they were seen flying high over the forest and then six or seven

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gathered to hawk flying-ants, circling close to a tree-top and uttering a low deep croak. Their size and stately flight distinguished them from the other Nightjars round the tree. The ears of one shot remained fully erect for some time after death, and its throat was full of wingless white ants, many still alive.

1636. **Tyto alba** THE BARN OWL.

1636A. **Tyto alba** THE BARN OWL.

I have seen a few in Hanthawaddy and around Rangoon. Harington describes it as common in Rangoon—I have not collected any.

[Dr. Hartert has shown that the Indian Barn Owl is not the same as the Javanese bird (Novit. Zool., xxxv, p. 98, 1929). He has named the Indian bird (type locality, Cachar) *stertens*. I have not gone into the question to which race Burmese birds belong.—C.B.T.]

1643. **Asio f. flammeus** SHORT-EARED OWL. 421.

I shot one on a sandy island on the Irrawaddy in Henzada on December 24th, 1930, which did not seem to mind the glare of afternoon sunlight on the sand at all. On February 3rd, 1931, I flushed another while walking pea-fields for quail near Yele, and in February 1932, two more out of paddy stubble close to the sea at Kamakalok in the Hanthawaddy district. All these birds had chosen remarkably shadeless places to lie in by day, and those at Kamakalok had undoubtedly been attracted by a plague of rats.

[No paler than some British examples of the same date.—C.B.T.]

1685. **Athene brama pulchra** BURMESE SPOTTED-OWLET.

This bird is certainly common in Henzada, but Harington observes (p. 55) that in Rangoon their place is taken by *Glaucidium cuculoides*.

1690. **Glaucidium cuculoides rufescens** BURMESE BARRED-OWLET. 211.

The only one seen for certain was obtained on the eastern side of the Pegu *yomas* at Aukkanyinmyaung in May 1923. Harington noted it as breeding in February near Rangoon.

1704. **Pandion h. haliaëtus** OSPREY.

I have seen this bird on Hlawga Lake in Insein and at various places in Lower Burma along the larger rivers up to the end of March.

Harington thought it might breed in Burma and, if it does anywhere, the lonely forest fringing the creeks near China Bakir seems admirably suited to this species.

1706. **Sarcogyps calvus** BLACK VULTURE.

Seen in small numbers all over the area. A pair were repairing a nest in Rangoon in early October and I found another pair in February nesting in the old Pilakat reserve. At the nest they are remarkably tame, even if a gun is fired near them.

One seen at close quarters in November 1931 had a noticeable white patch at the base of the neck.

1713. **Pseudogyps bengalensis** INDIAN WHITE-BACKED VULTURE.

Common. It breeds in cocoanut palms in Rangoon where I saw several incubating on November 9th and I saw others breeding in forest trees in the Mingalun reserve (Hanthawaddy).

The nests are usually made of dead leaves and branches with the leaves adhering.

1718. **Falco peregrinus calidus** EASTERN PEREGRINE FALCON.

It is fairly common all over the area from December to mid-April and is most frequently seen at dusk, when it often takes the same route night after night. Individuals were seen far out on the muds below the tide line.

A Peregrine haunted the roof of the Secretariat in November 1931, and used to puzzle me by lying flat on its belly on a narrow ledge with its wings spread out and its head towards the wall of the building. In this attitude it would remain for ten minutes or more at a time as if rubbing its feathers on the stone. I watched it on numerous occasions with glasses at close quarters, and could never make out what it was doing.

1719. **Falco peregrinus peregrinator** SHAHIN.

I saw one in the old mule-grazing ground at Yegu in October 1929, and

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had a good view of its rich rufous breast. This, and its large size, made it a most conspicuous bird.

1724-28. **Falco subbuteo?** HOBBY.
I have twice seen Hobbies in Henzada district at fairly close quarters but never managed to obtain them.

1741-42. **Cerchneis tinnunculus** KESTREL.
Fairly common from November to March throughout the area. Saw no signs of any breeding.

1745. **Cerchneis naumanni pekingensis** CHINESE LESSER KESTREL.
As already recorded (*Journal*, November 15th, 1932) I shot two males out of a large gathering which were presumably on migration at Lunbye in the Sittang Plain on April 1st, 1932. This is the first record for Burma.

1765-66-67. **Haematornis cheela** CRESTED SERPENT-EAGLE.
I had a close view of one in high forest on the Insein *yoma* in October 1929, but failed to obtain this, or others, seen later on.

1775. **Butastur liventer** RUFOUS-WINGED BUZZARD EAGLE.
I saw a party of five or six on January 23rd at Pauktaing in Henzada which from their actions seemed to be pairing. These birds are partial to teak forest on the border of cultivation and though apparently rather sluggish birds, they are extremely wary and difficult to get a shot at.

1778. **Haliaëtus leucogaster** WHITE-BELLIED SEA EAGLE.
Armstrong, who obtained one near China Bakir, describes it as 'found sparingly along the coast and very shy'. He also obtained *Icthyophaga ichthyaëtus* on the Rangoon river. I saw at least two species of pale-headed eagles on the creeks near China Bakir but failed to obtain any, or get a satisfactory view of them on the ground. The distribution in Burma of these two species and *Haliaëtus leucoryphus*, which are all stated to occur in Burma, urgently needs careful working out.

1784. **Haliastur indus** BRAHMINY KITE. ♂ 177.
Breeds all over the area, and in the south of the Sittang-Rangoon river plain sometimes very low down on account of the paucity of trees. I found both eggs and young birds in early February in Hanthawaddy. Only a small number appear to stay throughout the rains but possibly they move to the big jheels which are rarely visited at this time of year.

1787. **Milvus migrans govinda** COMMON PARIAH KITE.

1788. **Milvus migrans lineatus** BLACK-EARED KITE.
Immense numbers of these Kites appear in mid-September and early October, one of their principal strongholds being the woodlands round the Royal Lakes in Rangoon. Though I have never shot any, I have been able clearly to distinguish the slim, smaller chocolate-brown Kite which breeds, from the larger, darker Kite with a blackish back and yellow-white patches under the wing, which can be seen resting on waste ground throughout the day and which Harington says is the more numerous. *Govinda* undoubtedly breeds on the Secretariat in Rangoon, and all over the plain in small numbers down to the sea. I saw a pair of which the female was sitting on November 2nd, 1931, at Yegu, and another bird carrying sticks on November 4th. In the Sittang Plain, some of the nests are in very low and conspicuous positions owing to the shortage of trees.

The evening flight of Kites over the Royal Lakes is one of the features of Rangoon, and a large troop of them hawking flying-ants, when the latter are swarming, is a wonderful sight. The ants are frequently taken in the talons and transferred to the mouth. I watched one on November 5th, 1931, being attacked by a Peregrine just over the roof of the Secretariat, and as the Falcon stooped on its tail and dropped its claws, the Kite turned gracefully upside-down in the air and struck upwards at the Falcon with its claws—a manoeuvre requiring marvellous timing. *Lineatus* in the Sittang Plain is a village-haunting bird feeding largely on offal, and gathering in large numbers to roost in the few clumps of trees in the area.

1789. **Elanus caeruleus** BLACK-WINGED KITE. ♂ 529.
Not uncommon all over the area, and like the Kestrel, which in its habits

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it much resembles, a bird of the plains. I have seen as many as five or six together towards nightfall, when all *Raptores* congregate. I feel certain it breeds in Henzada as I saw two pairing in April, and individuals as late as mid-June, but have never found a nest.

1790. **Circus macrourus** PALE HARRIER.
I twice saw a single adult bird in 1931 crossing the Eikpyet jheel in Henzada, but very pale immature birds which I shot in the Sittang Plain turned out to be *melanoleucus*. I saw one adult near the Eastern Grove lighthouse in February. Oates seemed to consider this bird was common but I am inclined to doubt if it is at the present day.

1793. **Circus melanoleucus** PIED HARRIER. 2 ♂ 2 ♀ 71, 127, 130, 136.
Common all over the area from November to early April, both on marsh and stubble, and often allows a very near approach. I have watched a great many hunting, and small birds seem to take so little notice of them that their food must be principally mice, beetles, etc.

1794. **Circus æ. æruginosus** MARSH HARRIER. 3 ♂ 123, 126, 566.
Common all over the area, mainly on jheels but in the Sittang Plain in the wide grassy depressions which are jheels only in the rains, from November to mid-April.

1805. **Astur badius poliopsis** HUME'S SHIKRA.
Not uncommon and seems partial to bamboo jungle. In January one was frequently 'mewing' in my garden in Henzada and, on one occasion, when mobbed by *Corvus insolens* took refuge on the ground under a bamboo clump.

1811. **Accipiter nisus** SPARROW-HAWK.
Several times seen in Henzada in the foothills but I failed to obtain any.

1918. **Pernis ptilorhynchus** subsp. CRESTED HONEY-BUZZARD.
Seems to breed along the foot of the Henzada *yomas* and its curious note can be heard a long way off. I saw one which had a nest at Chondaung in Henzada in February 1931 and was told a pair nested there annually.

1827. **Crocopus phoenicopterus viridifrons** BURMESE GREEN PIGEON. ♂ 655, 216.
Common in Henzada but I shot very few Green Pigeons elsewhere. A male shot on February 17th was about to breed.
I noticed some feeding on the berries of the '*zi*' thorn. They were still in flocks on the eastern side of the Pegu *yomas* on May 10th.

1830. **Dendrophassa pompadora phayrei** ASHY-HEADED GREEN PIGEON. ♂ 628.
Not uncommon in the Lemyethna foothills (Henzada) in February; a male shot on February 13th was about to breed. Harington recorded it from Rangoon.

1836. **Dendrophassa bicincta** ORANGE-BREASTED GREEN PIGEON. ♂ 54.
One was shot out of a pair in the Zepathwe reserve on February 19th.

1846. **Muscadivora aenea** GREEN IMPERIAL PIGEON.
Seen in small numbers along the foothills in Henzada and Insein.

1852. **Chalcophaps indica** EMERALD DOVE.
Seen in small numbers in both Insein and Henzada and breeds in the cane-brake portions of the scrub jungle close to Rangoon.

1870-72. **Streptopelia orientalis** subsp. RUFOUS TURTLE DOVE.
In Lower Burma this is much more a jungle bird than *chinensis* or *oenopopelia*, and is rarely seen away from it. Occurs in some numbers in the Henzada and Insein foothills, and appeared to be breeding in the latter in late October.

1874-75. **Streptopelia chinensis tigrina** BURMESE SPOTTED DOVE.
Common and comes into the gardens round Rangoon to breed at the end of the rains.

1881. **Oenopopelia tranquebarica humilis** BURMESE RED TURTLE DOVE.
Very common in flocks from November to March. I saw pairs which were undoubtedly breeding in April in the sparse jungle on the north of the

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Yandoon Island (Maübin), but have not seen them elsewhere in the area during the breeding season.

1897. **Pavo muticus** BURMESE PEAFOWL.

It is said to be very plentiful in parts of the Henzada *yomas*. Mr. C. W. Scott, I.F.S., who has an extensive acquaintance with the Insein *yoma* reserves, states that peafowl are very rare in Insein, but that an occasional bird is reported as far south as Taikkyi.

Mr. E. O. Bloech confirms this and saw some still further south a few years ago.

1904. **Gallus bankiva robinsoni** BURMESE JUNGLE FOWL.

Very common in suitable places in all districts where it is not persecuted. I have seen some near the sea in the Zepathwe reserve and it still survives in the scrub-jungle, which has replaced the old forest between Mingaladon and Rangoon.

A hen, shot in a beat in January 1933, had a number of small firm tumours on the neck, legs and wings varying in size from a millet seed to a hazel nut. There was a group of seven or eight on the anterior margin of the wing, which prevented the bird flying.

I have seen eggs in late January. Many jungle-fowl live on the densely-wooded islands of the Hlawga Lake, apparently throughout the year. These birds are a long way from any source of grain supply, and I have seen wounded ones, dropped on the water, swim strongly to land.

1923. **Gennaeus lineatus** subsp. SILVER PHEASANT. 1, 2.

I failed to obtain any, except a pair shot near the seventeenth mile on the Rangoon-Prome Road by Mr. Mather which are now in the British Museum. The Insein Forest Division Working Plans Report states that they are very common in the Mahuya reserve.

1948. **Excalfactoria c. chinensis** BLUE-BREASTED QUAIL.

I have shot this in stubble in Henzada and seen it on the Kya-in swamp in Insein. It certainly breeds in some numbers during the rains in the long grass, both on the polo-ground in Rangoon and on the new race-course at Kyaikkasan where I flushed numbers in August.

1952. **Coturnix coromandelica** BLACK-BREASTED QUAIL. ♂ 578.

I shot a male of this species on the Irrawaddy pea-fields in South Henzada on February 3rd, 1931, with enlarged gonads and it was, I should say, breeding there in some numbers. All this land is under water by mid-June, so they presumably migrate locally before then.

1981. **Francolinus pintadeanus phayrei** PHAYRE'S BURMESE FRANCOLIN. ♂ 532.

Oates considered that this bird was not found below Prome. It is possible that it has extended southwards with the spread of cultivation and the rapid reclamation of swamp and forest due to the growth of population, embankments, etc. I have one or two records from the Insein district about 30 miles north of Rangoon, and it is certainly not uncommon in the Henzada district along the *yoma* edge within ten miles of the southern boundary of the district. I also heard Francolins calling in the Irrawaddy pea-fields below Henzada town. In some places I have heard ten or twelve birds calling simultaneously before dusk but have been unable to prove if they actually congregate to roost. It is a bird far more often heard than seen. As an instance of this bird's skulking powers, Mr. Gallant, I.F.S., and myself spent a fruitless evening looking and listening for Francolins near Legongyi, and at dawn next morning one was calling loudly from some bushes, where presumably it had been roosting, within 15 yards of our camp. Nothing we could do with beaters, etc., succeeded in dislodging this bird.

2008. **Turnix suscitator pallescens** PEGU BUSTARD-QUAIL. ♀ 635.

I shot a female which was not breeding at Legon (Henzada) on February 14th and Mr. Villar obtained one in the Kyangin reserve in March.

[These Turnix seem very variable and the series in the British Museum is none too good. *Pallescens* is possibly recognisable on the average of a series but it is not at all a distinct race.—C.B.T.]

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2008. **Hypotaenidia striata** INDIAN BLUE-BREASTED BANDED RAIL.
I saw several in the Insein district and have reason to believe it breeds on the Rangoon race-course at Kyaikkasan. I believe it to be a rains immigrant, as it is never seen at other times.

2022. **Amaurornis phoenicurus chinensis** CHINESE WHITE-BREASTED WATERHEN.
Common. In mid-May 1931 a pair bred in my garden in Henzada, the nest being 25 feet from the ground in a bamboo clump, a long way from water. The birds fed on my lawn morning and evening, apparently on insects. They were silent all day but occasionally indulged in their customary outbursts about dusk. There were one or two other nests in similar situations, and for a month or so, remarkably far from water.

2026. **Gallinula chloropus indicus** INDIAN MOORHEN.
Occurs in Henzada in small numbers.

2027. **Gallicrex cinerea** THE WATERCOCK.
I saw individuals in Henzada in flooded paddy land in the rains, where they were presumably breeding. This is rather a mysterious bird whose status is most difficult to define, and like the Chestnut Bittern, it is usually only visible in the rains.

2028. **Porphyrio p. poliocephalus** INDIAN PURPLE MOORHEN.
Common on suitable large swamps. I found these Moorhens flighting in large numbers at dusk to the rice-fields near the Kya-in swamp, where they were said to do a great deal of damage with their heavy feet.

2031. **Metopidius indicus** BRONZE-WINGED JACANA.

2032. **Hydrophasianus chirurgus** PHEASANT-TAILED JACANA.
Both these Jacanas occur all over the area, and on the jheels where they breed, the majority seem to leave after the breeding season.

2033. **Rostratula b. benghalensis** PAINTED SNIPE.
Probably resident, but little seen. In April 1931 I flushed a number feeding in dry grass a considerable distance from water.

2047. **Burhinus oedicnemus indicus** INDIAN STONE PLOVER.
The only ones observed were a breeding pair whose eggs I found on March 15th on a sandbank below Henzada. They were remarkably tame and completely silent and allowed a very near approach.
The eggs were sheltered from the afternoon sun by a tuft of grass growing on the sand.
I have never heard in Burma the wild and musical outcries so characteristic of this bird in its European breeding haunts.

2049. **Esacus recurvirostris** GREAT STONE PLOVER.
Not seen except for three birds seen on December 24th on a sandy island above Henzada, but I had little chance to explore some of the larger islands.

2055. **Glareola maldivarum** LARGE INDIAN PRATINCOLE.
Perhaps the most distinctive breeding bird of the great plains of the delta, both in Pegu, Henzada, Maübin, Pyapon and Hanthawaddy. These great expanses of burnt stubble in March and April exactly suit it as a breeding haunt, and though there are no large colonies, scattered pairs occur all over the area. Some nest on short grass, e.g at Eikpyet near Henzada, and I have seen a fair-sized colony on the Kyungale grazing ground, but the majority prefer the open stubble. In the late afternoon individuals can be seen hawking miles from their breeding grounds. It certainly remains in its nesting haunts till mid-June and Oates thought a few remained up to mid-August. I saw a small flock near Pazundaung on November 1st, 1931, so possibly some are resident throughout the year.

2056. **Glareola lactea** SMALL INDIAN PRATINCOLE.
Breeds in Henzada and Maübin on the Irrawaddy islands. A few probably stay throughout the rains and it becomes common again from November onwards.

2060. **Larus ichthyaëtus** GREAT BLACK-HEADED GULL. ♀ 57.
Armstrong did not meet with this Gull, which Oates mentions as abundant

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in the Sittang canal. I saw several on the sands at Wetkaik (Hanthawaddy) on February 20th, two at least of which appeared to be in full summer dress. I did not see any at Kamakalok during a few days' stay in April. This bird has the orbital skin crimson, a character noted by Hume but not in the *Fauna*. Its great size and black head and neck are distinctive field characters.

2062. **Larus brunneicephalus** Brown-headed Gull. ♂♂ 48, 59.
Winters in large numbers on the Rangoon river as far as Rangoon but does not seem to come up higher, except on migration. I saw several parties at Yandoon (Maübin district) on April 27th which were apparently migrants and saw a large flock of Black-headed Godwits at the same time.
I kept a look-out for *ridibundus* and though many immature birds seen following steamers look to me indistinguishable from European examples of *ridibundus*, I never saw a full-plumaged bird. This iris of immature *brunneicephalus* is olive-green but when mature the pale iris contrasts with the ash-brown head.

2068. **Chlidonias leucopareia indica** Whiskered Tern. 21, 70, 165-66, 170, 172.
I saw parties in Insein apparently migrating across country on October 5th and 15th, and a very large gathering on the Ingyi lake in Lemyethna (Henzada) on February 18th. On April 26th, a large number appeared below Henzada, hawking insects over the pea-fields.

2072. **Gelochelidon n. nilotica** Gull-billed Tern. 15, 62, 141-42, 161, 199.
It is curious that Oates never met this bird on the Sittang or elsewhere, as in January and February it was one of the most conspicuous birds of the vast paddy plain, to a distance of ten miles or so from the sea. Large numbers could be seen daily hawking over the stubble, and the pools and depressions left after the rains. Like the Whiskered Tern, I suspect this Tern feeds to a considerable extent on insects. I saw very large numbers in April and May all along the sea coast (Armstrong also noted its abundance in 1875-76), but those shot did not appear to be breeding and a bird in immature plumage was shot on May 5th. I found no suitable place for a breeding colony and all local Burmans, of whom I enquired, were positive that there was no place between the Sittang mouth and the Rangoon river mouth which was not covered by the spring tides. At the same time, the bird is so common that it almost certainly breeds somewhere on this coast or in the Andamans. I did not see this bird in Henzada, Maübin or elsewhere in the area.

2080. **Sterna aurantia** Indian River Tern. ♀ 570.
Breeds on the islands in Henzada and Maübin in some numbers. The local name for all Terns is '*zin-yaw*'. It occurs in Henzada from November to June but I am unable to say if some stay throughout the year. At dusk these Terns nearly always flight up or down the river, probably catching insects.

2081. **Sterna melanogaster** Black-bellied Tern. ♂♀ 583, 597.
This is the only freshwater Tern which habitually leaves the main rivers, and hawks over wayside ditches and ponds. Nests along the river in Henzada and Maübin, and one of a pair shot on February 8th had a large soft egg in the ovary. I saw a very big flight going north up the river on December 25th and some appeared to have paired already in this month.

2088. **Sterna albifrons sinensis** White-shafted Ternlet. 44, 45.
I shot individuals alongshore in February and saw a few single birds in April but saw no signs of breeding colonies alongshore. The only breeding colonies found were one in Maübin on an island in the Irrawaddy above Yandoon, and several in Henzada. I saw one nest with eggs on April 27th. I noted individuals in Henzada up to July.

2100. **Rhynchops albicollis** Indian Skimmer.
Breeds in small numbers both in Henzada and North Maübin on suitable islands along the river. It is a bird which, being so conspicuous, prefers to nest far out in the middle of a vast stretch of open sand, from which it can see an intruder a long way off.

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2101. **Strepsilas i. interpres** TURNSTONE. ♂ 156.
Armstrong did not meet with this bird, and I can only find one Burma record of a September migrant shot by Oates. I obtained a male—which may have been a newly-arrived immigrant—at Kamakalok, on April 16th, 1932. It was feeding busily in the middle of the afternoon, among a flock of sleeping *Cirrepidesmus* on grass-covered mud.

2102-03. **Squatarola squatarola** GREY PLOVER. 19.
Not met with by Oates, but by no means uncommon along the shoreline from Kyaikto to Elephant Point. Armstrong noted its shyness, and it is certainly less approachable than the Golden Plover and keeps to the tide mark especially where rocks occur. I did not shoot any in breeding dress to ascertain the race.

2106-07-08. **Leucopolius a. alexandrinus** KENTISH PLOVER. 16, 154, 594.
Armstrong noted that it was quite as abundant as *Cirrepidesmus* and I found it common on the mud flats and nearly always in their company all along the coast. Small parties haunt the Rangoon race-course at high tide, where they are very fond of the worn circles round which ponies are led, and I have twice seen parties in breeding dress—apparently on migration—on the Irrawaddy in late April. Pairs were seen mating on February 5th.

2110-11. **Haematopus ostralegus** OYSTER-CATCHER.
Neither Oates, Armstrong nor myself met this conspicuous bird for which I kept a careful look-out. Mr. S. F. Hopwood told me he had seen it some years ago on the beach at Letkokkon near China Bakir.

2113. **Charadrius dubius** LITTLE RINGED PLOVER. ♂ ♀ 185, 436, 466.
Among the many thousand waders seen by me daily on the sea-coast mud, I failed to detect a single Ringed Plover of any species. There is no doubt that in its winter haunts, this bird, and *not Cirrepidesmus*, is the real Sand Plover. A few *Ch. dubius* were to be seen on the sandy beaches (relics of former tide-marks) which occur in the paddy-fields, and they were frequently to be seen on threshing floors far out on the stubble, as also on the laterite ridge near Rangoon where the hard short grass seems to suit them. On the tidal mud, where the bulk of the waders congregate, they were not to be seen.

2117. **Cirrepidesmus mongolus atrifrons** LESSER SAND PLOVER. 20, 31, 195, 196, 204.
This bird is locally known to the Karens in Thaton as *dilon-gaung*, an allusion apparently to the brick-red colour of the crown and upper breast in breeding plumage. The *Fauna* accidentally omits any mention of its occurrence in Burma, but it occurs in immense numbers on the tidal mud of the coast line, and in small numbers up the tidal creeks.
It must pass up the Irrawaddy on migration, but no one seems to have recorded it.

2118. **Cirrepidesmus leschenaulti** LARGE SAND PLOVER. 64, 140.
Does not seem to occur in quite such numbers as *atrifrons*, but I saw a good many on the tide line and in April and May, when they look foxy-red with a black line through the eyes and on the forehead, they are remarkably beautiful birds.
The *Fauna* states that *leschenaulti* has a white forehead, but one seen in a good light seemed to have a completely black forehead and another obtained had black on the centre of the forehead.

2120. **Charadrius dominicus fulvus** EASTERN GOLDEN PLOVER.
Arrives with the first snipe about mid-August and is present in breeding plumage in the first week in May. It does not haunt the actual mud of the coast line, but is found on the grass above the tide line, on stubble and grazing-grounds, and also on the short grass covering the laterite ridges near Mingaladon. Numbers are caught by the Hlegu bird-catchers.
A bird shot on April 14th had a wing of 174 mm. (the *Fauna* gives 160-165).

2124. **Hoplopterus ventralis** SPUR-WINGED PLOVER. ♀ 595.
Common in the higher sandy reaches of the delta rivers, and on the hill streams, but not found within tidal limits. In Henzada and Insein it presumably performs a local migration when the river rises.

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2127. **Lobivanellus indicus atronuchalis** BURMESE REDWATTLED LAPWING.
Common in Henzada and Insein and a bird of the paddy fields. I have not seen it on shingle and sand-banks, nor within tidal limits.

2129. **Microsarcops cinereus** GREY-HEADED LAPWING.
Occurs from October to April on the edges of all the big jheels and is very common in the Sittang Plain on the big grassy depressions which in the rains are uncultivated swamps. The *Fauna* states that in Assam it is never found in flocks but I have seen quite large flocks in various parts of Burma.

2134. **Numenius arquata lineatus** EASTERN CURLEW. ♂ 160.
Very common on the tidal mud all along the coast, and seen up to May 10th. Armstrong remarks that they were always 'excessively shy', but I found them at first easy to drive by hiding in creeks or behind old stumps on the tide line. They are occasionally seen flying over Rangoon.

2135-36. **Numenius phaeopus** subsp. WHIMBREL.
Armstrong noted its abundance on the tide line, but thought it was not so common as the Curlew. In April 1932 my impression was that Whimbrel were the more numerous. In this area, both Curlew and Whimbrel follow the narrow winding creeks when feeding, far up into the interior, and I have frequently flushed them from under bushes almost at my feet, or in mangrove jungle, and once in high forest in the Pilakat reserve where one might expect to see a Jungle Fowl or a Pheasant, and certainly not such a shy and wary bird as *Numenius*.

2138. **Limosa l. melanuroides** BLACK-TAILED GODWIT. ♂♂♂♀ 138, 139, 192, 193.
I saw two or three large flocks on the tide line on April 13th and 14th, and a flock of forty on passage near Yandoon on April 27th on the Irrawaddy. Only two of this last flock showed any signs of assuming summer plumage, apart from rusty streaks on the throat. There was great individual variation in measurements and those of five measured by me, before skinning were: wing 188.5-204 mm.; culmen 75-97 mm.; tarsus 65-72 mm.
All these Godwits—and I examined a number which were shot and not preserved—had a conspicuous white patch immediately below the eye and a white supercilium, and the basal portion of the bill was deep mauve-pink (not as described in the *Fauna*).

2141-42. **Terekia cinerea** TEREK SANDPIPER. 43, 144.
Oates considered it common, but I never saw it far away from the tidal line of the sea and Armstrong described it as by no means abundant and only obtained two or three. I saw a good many at Kamakalok in February and mid-April, nearly all on the grass-covered mud above the normal tide line. Two obtained in April had bills of 47 and 52 mm. and were apparently of the western race.

2143. **Tringa ochropus** GREEN SANDPIPER.
Occurs from August to April all over the area and is never seen except singly or in pairs.

2144. **Tringa stagnatilis** MARSH SANDPIPER. ♂♀ 39, 525, 561.
Observed on jheels in Henzada and Insein, and individuals were seen near the coast with Redshanks and Spotted Shanks, both at small pools on the saltings. Its trivial name in Oates' day was the 'Little Greenshank' which well describes it, the sharp double note 'Kewip' being also distinctive.

2145. **Tringa hypoleucos** COMMON SANDPIPER.
Armstrong describes it as 'usually in small parties in cultivated lands and ploughed fields'. The Common Sandpiper in Burma is always, in my experience, a solitary bird, though one occasionally sees two together, and the description better suits the Wood Sandpiper or Temminck's Stint. The bird haunts the tidal creeks, even in dense mangrove jungle, but is not a bird of the mud flats. It is common on every river in Lower Burma.

2146. **Tringa glareola** WOOD SANDPIPER. ♀ 530.
Very common from August to April and occurs in immense numbers at the same time as the first Pintail Snipe come in. Later it is spread over

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every jheel and along every river, but is a bird of fresh-water and does not occur on the tidal mud.

2148. **Tringa totanus terrignotae** Central Asian Redshank. 14, 36, 37, 150-52, 152a, 163.

Very common in flocks at Kamakalok and also on the Kyaikto estuary from February to early May. All those shot in April were identified as *terrignotae*, and were very heavily spotted on the throat, breast and sides, and showed traces of cinnamon brown on the crown and back. In February some of these birds had a noticeably pale supercilium (specimens measured fresh were as follows: wing 155-170 mm.; culmen 42-47 mm.; tarsus 47-52.5 mm.).

2149. **Tringa erythropus** Dusky Redshank

A few were seen with *terrignotae* at Kamakalok in February.

2150. **Glottis nebularia** Greenshank. ♀ 490.

Abundant in every part of the five districts, both on jheels, rivers and the tide line, and in February and March sometimes assembles in large parties.

I kept a close look-out for Armstrong's Sandpiper (*Glottis guttifer*) which was shot out of Sand Plovers near China Bakir in December 1875, but until someone describes the field characteristics of this bird, it will probably go unrecorded.

2155. **Erolia m. minuta** Little Stint. ♀ 202.

2156. **Erolia m. ruficollis** Eastern Little Stint. ♂ 145, 146, 153, (winter) ♂ 526.

Common along the Sittang-Rangoon River coast line, its favourite haunts being the grass-covered mud just above the normal tide limit. Many undoubted *ruficollis* were seen at Kamakalok in April, the rufous cheeks and throat being most noticeable. I obtained a single *minuta* on Kyaikto estuary (Thaton) on May 6th, in spring dress with dark-brown ear coverts and no trace of rufous on cheeks or throat.

I obtained one in Henzada but the bulk of the Stints seen there were *temminckii*.

2157. **Erolia subminuta** Long-toed Stint. 60, 61, 147, 155, 157, 164, 166, 168.

Oates described this bird as abundant all over Pegu and it is curious that Armstrong did not apparently meet with it. I shot one when snipe shooting inland in Insein, but failed to detect it in Henzada.

It was common on the coast line, and in April and early May could be easily distinguished by its remarkably dark, almost black, crown and upper parts, contrasting strongly with the pale rufous, or whitish grey of *E. minuta*. One shot on February 20th had the first primary on both sides in sheath and about an inch long.

2158. **Erolia temminckii** Temminck's Stint. ♂ 432, 180-81, 189, 190, 213-14.

Away from the coast line, where Armstrong did not meet it, and I saw very few indeed, in February, this Stint is the commonest Stint in Lower Burma. I have seen considerable flocks on the Eikpyet jheel in Henzada in December and at various places when snipe shooting, in August and September. In April, I failed to detect a single one among the thousands of waders on the coast but shot numerous specimens along streams inland in the Pegu district and on the sandy islands of the Irrawaddy near Yandoon.

The late F. M. Ogilvie had a theory that *E. minuta* and *temminckii* had quite different food and feeding grounds, and in Burma, except when on passage, *temminckii* seems to haunt much the same terrain as the Common Sandpiper, being partial to sand and fresh water, and not a bird of the tidal mud.

2160. **Erolia testacea** Curlew Sandpiper. 34, 148, 158, 165.

Common alongshore, and in mid-April, many were seen in breeding plumage, others not having yet changed at all. It is certainly not spread over the whole of Burma as the *Fauna* suggests, and Armstrong described it as 'by no means common' at the mouth of the Rangoon river.

2161a. **Calidris c. canutus** Knot. ♂ 143.

Armstrong obtained a specimen near China Bakir, apparently *tenuirostris*,

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and describes it as 'rare'. I shot an example of *canutus* just assuming its spring dress, out of a flock of Curlew Sandpipers and Sand Plovers at Kamakalok on April 14th, 1932 (culmen 31 mm.; tarsus 30 mm.; wing 160 mm.). There are only two previous Indian records, and I saw no other Knots among the many thousand waders on this coast.

2164. **Limicola falcinella sibirica** EASTERN BROAD-BILLED SANDPIPER. 40, 149, 149a, 203.

Armstrong described it as 'excessively common along the coast and up the Rangoon river as far as the Pegu river mouth'. It is curious that Oates only obtained one. I found it common from Kyaikto to the China Bakir, in the company of Stints, *Cirrepidesmus* and Kentish Plovers, up to the first week in May. I never saw individuals feeding alone and it was not easy to get near among the large flocks of waders. The *Fauna* gives the wing measurements as 100-111 mm. I shot two of 113.5 and 114 respectively.

2167. **Scolopax r. rusticola** WOODCOCK.

Easily overlooked but a regular winter visitor to the wet jungle all along the Pegu *yoma* where Mr. E. W. Bloech tells me he shoots a number every year. It is probably common right down to Rangoon but many of its haunts are never disturbed. Mr. E. W. Allan found it common at Sababontaung in the Henzada-Arakan *yomas* at about 3,000 ft.

2170. **Capella g. gallinago** COMMON SNIPE.

All over Lower Burma, this bird appears to be a much later arrival than *stenura* and is a bird of the paddy (particularly the winter planted *mayin* paddy) and of the jheel-side, whereas *stenura* is a bird of the grasslands and bogs round which cane-brake, etc., flourish.

2173. **Capella stenura** PINTAIL SNIPE.

Arrives in mid-August in incredible numbers, and in addition to the large numbers shot, thousands are caught in hand-nets at night by professional fowlers, who use a wooden bell or *Kalauk* and a lantern. The *Kalauk* apparently deceives the snipe into thinking the fowler is a grazing buffalo.

2175. **Lymnocryptes minima** JACK SNIPE.

This bird must be rare as I have never seen one, or heard of one being shot, except one obtained by Mr. E. B. Bloech, twenty-five years ago, near Ledaunggan in the Insein district. Mr. Bloech has probably shot more snipe in Lower Burma than almost anyone and he only remembers one other being obtained. Hume had one brought him from near Rangoon (BB., ii, 385).

[2176-79. **Pelecanus** sp.? PELICAN.

Apart from a single bird seen swimming on the Victoria Lakes at Rangoon on December 14th, 1931—which was too far off to identify—I have never seen one in Lower Burma. I was assured by villagers that Pelicans still breed in the remnants of the forest along the right bank of the Sittang but I failed to get there in the breeding season. Most of the area where Oates found them has long since been cleared of its timber.]

2180. **Phalacrocorax carbo sinensis** LARGE CORMORANT.

Seen on various jheels in Henzada, and on the Hlawga lakes where, according to Harington, it bred in January. A few haunt the *yoma* streams of Henzada.

2182. **Phalacrocorax niger** LITTLE CORMORANT.

Local name:—*Awyaw*.

Breeds at various places throughout Henzada district both in bamboo and toddy palms in company with *Bubulcus coromandus*, commencing in May.

2183. **Anhinga melanogaster** INDIAN DARTER.

Common throughout the year.

2203. **Threskiornis melanocephalus** WHITE IBIS.

I have seen large flocks in February in parts of Henzada and it is abundant on and near the sea coast in the Sittang-Rangoon River area.

2215. **Anastomus oscitans** OPEN-BILL.

This bird was very common in April in the Yandoon Island, where it was spread all over the dry plain feeding.

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2216. **Ardea purpurea** PURPLE HERON.
Occurs throughout the area but is nowhere common. Wickham believed it bred in Henzada but I did not discover it, and visited none of the large jheels in the rains.

2218. **Ardea cinerea** subsp.? GREY HERON.
Very common on the Irrawaddy and Hlaing Rivers, large gatherings being observable on the backwaters in December and January. Oates did not find it breeding. It was also common on the tide-line in company with *Herodias alba*. I found a colony of about ten pairs with half-built nests in a huge *Ficus* tree in the Kwingank Police Station compound (Henzada) on February 11th. They were not at all shy but were afterwards greatly disturbed by the huge influx of surrendered rebels in early March, 1931.

2223. **Herodias alba** subsp. LARGE EGRET.

2224. **Herodias intermedia** subsp. SMALLER EGRET.
I have never been able to distinguish the latter in the field but *alba* occurs all over the area and on the sea-coast is remarkably common. As the tide comes in hundreds can be seen belly-deep in the shallow water often two or three hundred yards out to sea.

2225. **Egretta g. garzetta** LITTLE EGRET.
Seen in small numbers all over the area. The black legs and yellow feet are a noticeable field characteristic.

2226. **Bubulcus ibis coromandus** CATTLE EGRET.
Common in the whole area and breeds from May to August, often with *Phalacrocorax niger*, and usually in close proximity to houses.

2229. **Ardeola grayii** INDIAN POND HERON.
Extremely common, especially on the huge expanse of grass-covered mud near the sea, where hundreds can be seen, looking oddly like Curlews in the distance.

2231. **Butorides striatus javanicus** LITTLE GREEN HERON. ♂ 625.
Common along the smaller streams and found within tidal limits in forest. One shot on February 13th showed signs of being about to breed.
[♂ juvenile wing 183 mm.—C.B.T.]

2233. **Nycticorax n. nycticorax** NIGHT HERON. ♂ 524.
Common, and I have seen some big breeding colonies in Henzada and Insein in the rains, often with Cattle Egrets and Cormorants, so that the din of the colony never ceases day or night.
The Burmese name 'lin-wet', which I believe to mean the 'twilight pig', aptly describes the confused squealing which goes on when a colony of Night Herons is waking up at dusk or returning to roost at dawn.

2237. **Ixobrychus s. sinensis** YELLOW BITTERN.
Rarely seen and possibly a summer migrant arriving to breed and leaving in October.

2238. **Ixobrychus cinnamomeus** CHESTNUT BITTERN.
From the start of the rains, this bird becomes very common and conspicuous in Lower Burma and by no means crepuscular. Individuals can be seen chasing each other or flying to their nests at all hours of the day. In Henzada I saw none before May 24th but possibly like *Butorides striatus*, the breeding colonies split up over a wide area in the dry weather and are thus rarely seen. I found it breeding in July in bamboo with Cormorants, Cattle Egrets and *Dupetor flavicollis* near Henzada.

2239. **Dupetor flavicollis** BLACK BITTERN.
I found it breeding in July in bamboos along a stream in Henzada, with Cattle Egrets, *Ixobrychus*, Cormorants, etc., and repeatedly saw birds flying high from the Hlawga Lakes (Insein) in the rains to a nesting ground some two miles away to the South-West.
Except in the rains, I have never seen it.

2240. **Botaurus s. stellaris** BITTERN.
I flushed one in February 1930 out of rough grass on the huge Kya-in swamp in the Bawle Island in Insein. I failed to secure it but was quite

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satisfied of its identity. This is much larger, and quite unlike, any of the other Burmese Bitterns.

2247. **Sarkidiornis melanotus** COMB DUCK.
Occasionally seen in Insein and Henzada but owing to persecution by Burmans, it is getting a rare bird now.

2248. **Asarcornis scutulatus** WHITE-WINGED WOOD DUCK.
I saw a pair in December 1925 in the Paunggyi valley of the Insein district, and it probably survives still in the remote and heavily-wooded jheels of the *yoma* foothills. Oates (BB., ii, 281) was very sceptical of its occurrence in Pegu, but in this country it could be easily overlooked and Mr. C. E. Milner tells me he saw it in Tharrawaddy before the war.

2250. **Nettapus coromondelianus** COTTON TEAL.
Very common indeed on certain jheels in Henzada and Insein up to March. After that these birds split up and breed all over the country, sometimes miles from water. Sir Harcourt Butler recorded some years ago a case of a Cotton Teal nesting in the roof of Government House.

GEESE.
I have never seen or heard of any geese in the area.

2260. **Dendrocygna javanica** LESSER WHISTLING TEAL.

2261. **Dendrocygna fulva** LARGE WHISTLING TEAL.
Both occur in Henzada and Insein but are much persecuted by every Burman with a gun, and no longer common. I shot *fulva* flighting to a patch of rice in the Bawle Island along with Pintail and other ducks.

2262. **Tadorna tadorna** SHELDRAKE.
I saw a pair on the Irrawaddy above Henzada on December 24th, 1930, as already recorded in the *Ibis*.

2263. **Casarca ferruginea** RUDDY SHELDRAKE.
Not uncommon above tidal limits. It is a bird of the sand. Two small parties seen flying west to east near Mingaladon on November 21st were probably newly arrived immigrants.

2270. **Mareca penelope** WIGEON.
This seems to be a rare bird but Mr. Bloech tells me he has occasionally shot it on the Hlaing River in Insein.

2271. **Nettion c. crecca** COMMON TEAL.
Occurs throughout Henzada, Maübin and Insein in small numbers and I saw four with Garganey on a tidal creek close to the sea. This Teal and Garganey were the only ducks seen near the shore at all.

2274. **Dafila a. acuta** PINTAIL.
I have seen flocks in Henzada and shot birds in Insein but it is such a shy duck that it is rarely obtained, and haunts the big jheels in Maübin and the Bawle Island which are very difficult of access.

2275. **Querquedula querquedula** GARGANEY TEAL.
I saw large gatherings in February and March in various parts of the area and it is probably the commonest duck in the area in winter. I saw many on a tidal creek close to the sea in mangrove jungle on February 20th.
In the latter country *Nettion albigulare* is likely to occur as it has been obtained in the Bassein district.

2276. **Spatula clypeata** SHOVELLER.
Not common. I saw a pair of drakes on the big *Ye-gyi* swamp in Henzada in February 1931 and Mr. Bloech has occasionally shot it in the Insein district.

2283. **Nyroca f. fuligula** TUFTED POCHARD.
I have seen small parties on the Kya-in swamp in Insein and near Letpanbin in Henzada.

2292. **Podiceps ruficollis capensis** INDIAN LITTLE GREBE. 574.
Seems to be resident and not uncommon. Several pairs were breeding in borrow pits below the Eikpyet retirement in Henzada in July 1931. In summer this bird shows a bright yellow patch just in front of the eye, contrasting with the chestnut head.

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A NEW DRAGONFLY FROM LOWER BURMA.

BY

Lt.-Col. F. C. Fraser, I.M.S. (Retd.), F.R.E.S.

While examining a series of *Tetrathemis platyptera* in my own collection, I came upon a couple of males from Mergui, Lower Burma. There was nothing in them to excite interest except that I did not remember receiving any of that species from Lower Burma. I examined the markings to see if there might be any racial differences present but except that the labrum bore two basal spots of yellow and the terminal segments of the abdomen were unmarked I could see no departures from type. The absence of abdominal markings could be explained by decomposition changes obliterating them after death. The wings bore no trace of the usual basal yellow colouring but this is not uncommonly absent in teneral specimens. I was about to put them aside when I chanced to glance at the venation of the wings and was astonished to find that this differed entirely from that of *Tetrathemis*. It would be difficult to find two insects of different genera so closely alike in size, colouring and markings, and it was therefore not difficult to see how they had come to be overlooked on first receipt. This is not a case of mimicry but one of similarity by convergence probably brought about by the response to similar local influences and surroundings.

These two specimens belong to a new genus which by its archaic characters lies at the base of the family *Libellulidae* and form a connecting link between the two first groups as defined by the late Dr. F. Ris, viz., groups *Tetrathemis* and *Amphithemis*.

Systematic.

Genus: *Phyllothemis* gen. nov.

Head moderately large; eyes meeting broadly; forehead markedly rounded and without a frontal ridge; frontal sulcus shallow; vesicle high, two-pointed. Posterior lobe of *prothorax* rather large, rounded, not fissured at its middle; *thorax* rather small. *Legs* long and slim; hind femora with a row of very small, very closely-set spines of even size throughout; *abdomen* short, slim, dilated at both ends, cylindrical in the middle segments; *genitalia* prominent, the lamina very large, hood-like and projecting markedly, the hamules small and inconspicuous. *Wings* hyaline, uncoloured, narrow, the hind not noticeably broader than the fore; reticulation moderately close; discoidal cells at the same level, that of forewing with but a slight and very distal bend in its costal side, triangular, its distal and basal sides decidedly longer than the costal, that of the hind slightly or markedly distal to the level of the arc, both entire; arc between the second and

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third antenodal nervures; sectors of arc with a long fusion; *Cuii* and *IA* arising together from the anal angle of the discoidal cell in hindwing; 11 to 12 antenodal nervures, the last complete; *Rspl* indistinctly built, only a single row of cells between it and *IRiii*; 1 cubital nervure in forewing, 2 in the hind; no accessory nervures to the bridge; all *hts* entire; 1 row of cells in the discoidal field for a distance of 4 to 5 cells, after which the field is widely dilated to the border of wing; anal loop very small, made up of 5 to 6 cells only; pterostigma rather short; membrane nearly obsolete. Genotype: *Phyllothemis eltoni* sp. nov.

Phyllothemis eltoni sp. nov.

Male.—Abdomen 19 mm.; hindwing 22 mm.

Head: labium bright citron yellow the middle lobe at its centre and the lateral lobes at their borders broadly black; labrum black with two triangular basal citron yellow spots; face bright yellow as also a large spot on each side of frons, the latter and vesicle dark metallic blue; occiput dark brownish black; eyes probably green during life. Prothorax black, the anterior and posterior lobes bright greenish yellow, the latter narrowly black at base; thorax black dorsally marked with a narrow antehumeral greenish yellow stripe on each side and an oval humeral spot above, which lies transversely and is confluent with the yellow antealar sinus; laterally greenish yellow with a very broad black median oblique stripe; black beneath. Legs black, coxae and trochanters yellow; abdomen black marked with citron yellow as follows:—segment 1 with a large quadrate spot on each side; segment 2 with two large baso-lateral spots and a small rounded spot on its middle; segment 3 with a tapering stripe on each side and a linear spot on the middorsum beginning after the jugal suture; segments 4 to 7 with the median stripe-like spot only. Anal appendages twice the length of segment 10, superiors curved, dilated at the apical end, acutely pointed at apex and with a ventral spine below just before the apex; inferior triangular, its apex upturned. Female unknown. Type in my own collection.

Distribution: King Island, Mergui, Lower Burma. Two males taken by Mr. J. Elton Bott, during September. This species closely resembles *Tetrathemis platyptera* and cannot be distinguished from it on the wing, nor without examining the venation, save by the presence of two yellow spots on the labrum. The genus appears to lie somewhere near *Orchithemis* but is distinguished by the genitalia, the discoidal cells untraversed as well as the *Hts*, by the anal loop better formed and *Cuii* arising from the anal angle of discoidal cell, etc.

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THE BUTTERFLIES OF SECUNDERABAD.

BY

LT.-COL. W. E. M. LOGAN HOME.

As no article on Secunderabad butterflies seems to have appeared in the *Journal*, I thought it might interest readers to know what species occur there. I have included all butterflies met with in a radius of 10 miles of the Secunderabad Club, though as a matter of fact, the majority of species I actually caught in my own garden, ½ mile from the Club. The period covered was one year, from February 1933 to February 1934.

A. PAPILIONIDAE.

1. **Tros hector** (Ev. A. 2. 9). Common everywhere throughout the year.

2. **Tros aristolochiae aristolochiae** (Ev. A. 2. 10). Common everywhere throughout the year.

3. **Papilio polymnestor polymnestor** (Ev. A. 4. 1. b). Rare; two seen, one in the Residency garden in Hyderabad in March 1933 and one in my garden in February, 1934.

4. **Papilio polytes romulus** (Ev. A. 4. 25) N.R. throughout the year.

5. **Papilio demoleus demoleus** (Bv. A. 4. 27. α). Common everywhere throughout the year.

B. PIERIDÆ.

6. **Delias eucharis** (Ev. B. 6. 3). Very common everywhere. This butterfly appears to be more richly coloured in the Secunderabad area than elsewhere; I have compared specimens with those taken from Coorg, Nilgiris, Deolali, Ajmer, etc., many of the ♀♀ taken in my garden were yellow on the upperside as well as underside. I have not seen this in specimens elsewhere; perhaps some members could give some further data about this?

7. **Belenois mesentina mesentina** (Ev. B. 8. β). Common in the gardens in the cantonment, less common outside. This species also appears to be more highly coloured in Secunderabad than elsewhere in India.

8. **Huphina nerissa evagete** (Ev. B. 9. 2. α). Common everywhere.

9. **Catopsilia crocale.** Not common. A few seen at the end of the Monsoon.

10. **Catopsilia pomona.** Rare. One taken during the Monsoon.

11. **Catopsilia pyranthe.** Common during the Monsoon months. Not seen between October to June.

12. **Terias libythea** (Ev. B. 15. 1). Very common everywhere.

13. **Terias mecabe simulata** (Ev. B. 15. 5. α). Common during the Monsoon; scarce from October to June.

14. **Ixias marianne** (Ev. B. 17. 1). Common during the Monsoon. Not seen afterwards.

15. **Ixias pyrene frequens** (Ev. B. 7. 2. β). Not common. A few seen in the jungle towards close of the Monsoon.

16. **Colotis fausta fulvia** (Ev. B. 18. 4. α). N.R. Met with throughout the year, chiefly in grass jungle.

17. **Colotis e. etrida** (Bv. B 18. 5. β). Common in the scrub jungle outside the cantonment.

18. **Colotis danae danae** (Ev. B. 18. 7. α). Not common. A few seen in the grass jungle. Those caught appeared to be larger and more highly coloured than Coorg, Deolali and Palnis specimens.

19. **Pareronia valeria hippia** (Ev. B. 20. 3). N.R. This species appeared at the end of the Monsoon and disappeared again in January.

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C. Danaidae.

20. **Danais limniace mutina** (Ev. C. 2. 9). Not common. An occasional specimen seen in my garden and outside the cantonment.

21. **Danais plexippus** (Ev. C. 2. 12). Not rare. This species was not seen till the Monsoon, it occurred up to January.

22. **Danais chrysippus** (Ev. C. 2. 15). Very common everywhere.

23. **Euploea core core** (Ev. C. 3. β). Not rare. This species was not seen till October; it continued till February.

D. Satyridae.

24. **Mycalesis mineus polydecta** (D. 2. 10. *a*). Not rare. It did not appear till the end of the Monsoon and disappeared in January.

25. **Lethe europa ragalva** [D. 3. 23. (24*a*)]. In my garden. The specimen caught has very much longer 'tails' than I have seen elsewhere.

26. **Ypthima asterope mahratta** (D. 14. 6). Common in the scrub jungle outside cantonments.

27. **Melanitis leda ismene** (D. 22. 1). Common everywhere.

F. Nymphalidae.

28. **Charaxes fabius fabius** (Ev. F. 1. 7. β). Rare. 2 seen; one sitting on lantana, when I hadn't a net.

29. **Eriboea athamas agrarius** (Ev. F. 2. 2. β). Rare. 1 only seen.

30. **Euthalia nais** (Ev. 28). Not rare. Seen throughout the year, generally in rocky jungle.

31. **Neptis hylas varmona** (Ev. F. 26. 6. *a*). Not common. Seen at the end of the Monsoon occasionally.

32. **Hypolimnas misippus** (Ev. F. 30. 1). Very common everywhere.

33. **Hypolimnas bolina** (Ev. F. 30. 2). Not rare. Mostly seen outside the cantonments.

34. **Precis hierta hierta** (Ev. F. 35. 1. *a*). Not rare; never very common; but met with throughout the year, in the proportion of about 1 to every 100 *P. orithya*.

35. **Precis orithyea swinhoei** (Ev. 35. 2. *a*). Very common everywhere.

36. **Precis lemonias vaisya** (Ev. 35. 3. *a*). Very common everywhere.

37. **Precis almana almana** (Ev. 35. 4). Not rare; generally round paddy-fields.

38. **Precis atlites** (Ev. 35. 5). Not common. A few seen at end of the Monsoon round some paddy-fields 8 miles out of Secunderabad.

39. **Precis iphita pluviatalis.** Rare. Only one seen, in my garden, during the Monsoon.

40. **Vanessa cardui** (Ev. F. 36. 1). Not rare; from October to February.

41. **Atella phalanta** (Ev. F. 42. 1.). Common at the end of the rains for about 2 months, after which it was seldom met with.

42. **Ergolis ariadne indica** (Ev. 40. 1. β). Common during the Monsoon months till October, after which it disappeared.

43. **Telchinia violae** (Ev. F. 52). Very common everywhere throughout the year. The commonest butterfly in Secunderabad. The larvae swarmed all over the 'Mudpot' golf links throughout the year.

H. Lycaenidae.

44. **Spalgis epius epius** (Ev. H. 8. *a*). Rare. Only one seen, in my garden, in January.

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45. **Castalius r. rosimon** (Ev. H. 11. 1). Not rare, at the end of the Monsoon, after which it disappeared.

46. **Tarucus nara** (H. 12. 9). Rare. A few seen during the Monsoon.

47. **Syntarucus plinius** (H. B). Not rare; at the end of Monsoon and up to March.

48. **Zizeeria trochilus putli** (H. 24. 1). Not rare; after the Monsoon till March.

49. **Zizeeria lysimon** (H. 24. 4). Not rare; throughout the year.

50. **Zizeeria otis decreta** (H. 24. 6. α). Very common everywhere throughout the dry months, scarce during the monsoon.

51. **Catacrysops strabo** (H. 27. 1). Not rare during and at the end of Monsoon; scarce in the dry months.

52. **Lampides boeticus** (H. 28). Common throughout the year.

53. **Jamides bochus** (H. 29. 1. α). Not rare during the Monsoon, after which it disappeared.

54. **Jamides c. celeno** (H. 29. 5. β). Common everywhere during the Monsoon, scarce afterwards.

55. **Nacaduba n. nora** (H. 32. 15). Not rare at the end of the Monsoon; it gradually disappeared.

56. **Nacaduba dubiosa indica** (H. 32. 16). Common throughout the Monsoon up to January.

57. **Curetis thetis** (Ev. H. 44. 1). Not common. A few seen, mostly ♀♀, during the Monsoon months.

58. **Spindasis v. vulcanus** (H. 57. 1. β). Not rare during the Monsoon and up to January, after which it was not seen.

59. **Spindasis l. ictis** (H. 57. 6. β). Rare. A few seen and 2 caught in August flying round a single tree at the top of a hill. No others seen anywhere.

60. **Tajuria jehana** (H. 60. 18). Common at the end of the Monsoon, not seen from December to July; noticeably smaller than Bombay specimens.

61. **Rathinda amor** (H. 76). Rare. Only 1 seen.

62. **Rapala schistacea** (H. 85. 12). Not common. Occurred during the Monsoon months till December.

63. **Rapala melampus** Not rare. Just seen in August, when a number were seen flying round the same tree where *S. ictis* were seen. Later I caught it in my garden in January.

I. Hesperiidae.

64. **Hasora a. alexis** (Ev. I. 1. 16). Appeared in numbers in July-August, not seen at any other time. This insect only flew at dawn and dusk, disappearing during the day-time, like Asthopaetus, Capila etc.

65. **Coladenia indrani indra** (Ev. I. 20. 2. β). Not rare during the Monsoon.

66. **Gomalia elma albofasciata** (Ev. I. 27. α) Rare. 2 only seen and caught, in my garden, in August.

67. **Syrichtus galba** (Ev. I. 28. 2). Common everywhere throughout the year.

68. **Suastus g. gremius** (Ev. I. 47. 1. β). Common everywhere throughout the year.

69. **Astycus augias** (Ev. I. 91. 1. α). Rare. Only 1 seen in September.

70. **Baoris b. bevani** (Ev. I. 97. 34. β). Common throughout the year.

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SOME OBSERVATIONS ON *NYMPHAEA PUBESCENS* WILLD.

BY

CHARLES MCCANN, F.L.S.

(*Assistant Curator, Bombay Natural History Society*).

(*With two plates and one text-figure*).

The Water-Lily, *Nymphaea pubescens*, needs no introduction. It is a plant common in most tanks and pools in India. Though so common, much of its life-history is still obscure. The observations recorded in this paper are based purely on field study—a close observation of the plants in their natural habitat. D'Almeida has contributed an interesting paper on this *Nymphaea* to the Journal of the Indian Botanical Society, vol. v (1926), p. 62.

DESCRIPTION.

Rhizome: To understand the true nature of the rhizomatous stem of *N. pubescens* it is best to follow its development from the seedling, and its subsequent growth. In my opinion, *N. pubescens* does not flower in the first season or two (perhaps more) of its existence—not until such time as the rhizome is large enough to contain a fair surplus of reserve material. In shallow water the activity of these plants is very limited. During the first season of its activity the young plant develops a rosette of a few small submerged leaves, and a few roots. Amidst the roots a small ovoid or rotund 'tuber' is developed—the future rhizome.

The plant next rapidly produces three or four small leaves, as many roots, and a small rhizome. The young plant grows near the margin of the tank in shallow water, and as the water dries up the leaves disappear and the newly formed rhizome is left to tide over the dry season. Activity is resumed with the next monsoon, the plant producing larger and more numerous leaves and roots and ultimately a larger rhizome, and so on year by year till the rhizome is large enough to produce flowers and fruit.

At the close of each vegetative season and the drying up of the pool the leaves, and finally the roots, are lost. The rhizome may then be found either free on the surface or imbedded in the soil. If free, the rhizome may be washed into a deeper portion of the pool with the rush of water at the break of the next monsoon.

The rhizome during the vegetative period always anchors itself to the substratum by numerous spongy roots developed at the base of each petiole or from any point lower down. D'Almeida affirms that 'the rhizome is not buried in the mud at the bottom of the pond like those of other Water-lilies'. Whether the rhizome is only anchored to the substratum by roots or imbedded

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in the soil is, in my opinion, a matter of circumstance. I have found rhizomes anchored and imbedded—this would depend on the movement of the silt at the bottom of the tank. During the dry weather the rhizomes retain their roots as long as there is moisture in the soil, but in the case of anchored rhizomes the roots soon die away leaving the rhizomes free on the surface. When thus situated, rhizomes may be moved about freely by various agents. It is only necessary to dig up the bed of a tank where *Nymphaeas* are known to grow, during the dry season, to see the number of rhizomes that are turned out!

With the break of the next monsoon the free rhizomes may be seen rolled about by the inrush of water. They usually keep moving about at the water level till fresh roots are developed which anchor them. Numerous rhizomes are cast about in this way. An examination of one of these free rhizomes, particularly if it be an old one, may show that its lower end is in a partially decomposed condition. This decomposing portion is sometimes broken off by the action of the water, leaving only the active portion which soon grows a fresh outer coating around the exposed tender tissue (solid rhizomes do not float). In some cases the decomposing area is so large that it acts as a float due to the gases within. In this way the rhizome is kept at the surface of the water for a considerable time—until the decomposed area falls away from the active portion, which sinks to the bottom. In this way an active rhizome is carried about from one part of the tank to another by currents and wind. It generally comes to rest near the bank or it may sink anywhere as it is blown across the tank. This may possibly be a natural device to enable the plant to change its ground!

Normally, the rhizome grows vertically imbedded in the substratum. With the advance of growth and the rise in the level of the soil it tends to elongate and it becomes broader above. It may be described as obovate or spindle-shaped. I have frequently obtained such rhizomes measuring 20-25 cm. long and about 10 cm. broad when in the fresh state; but they shrink very much when dry. Generally the rhizome has but a single growing point, but may frequently 'branch'—showing several growing points. Possibly these 'branches' eventually separate by forming absciss layers. This point needs further investigation. As the rhizome elongates, the lower portion decomposes internally, leaving a hard woody shell. At the death of the rhizome the roots are lost, leaving it free in the substratum. Presumably, due to the decomposition gases within the outer shell, the entire rhizome rises out of the soil and floats to the surface of the water. Hollow rhizomes are frequently found floating in tanks. They form excellent harbours for aquatic insects.

Another point worthy of note is that rhizomes occasionally produce secondary ovoid or roundish 'tubers', 1-4 cm. long, on short or long stolons (Plate I, 1, A). This I have noticed in anchored and imbedded rhizomes both young and old. Surrounding an anchored rhizome, I once found several detached roundish 'tubers' which had evidently separated from the parent rhizome to which

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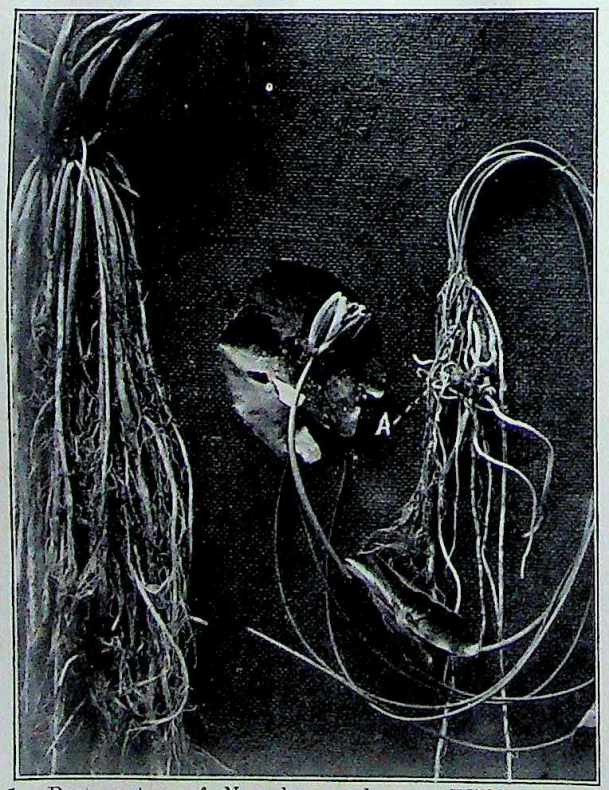
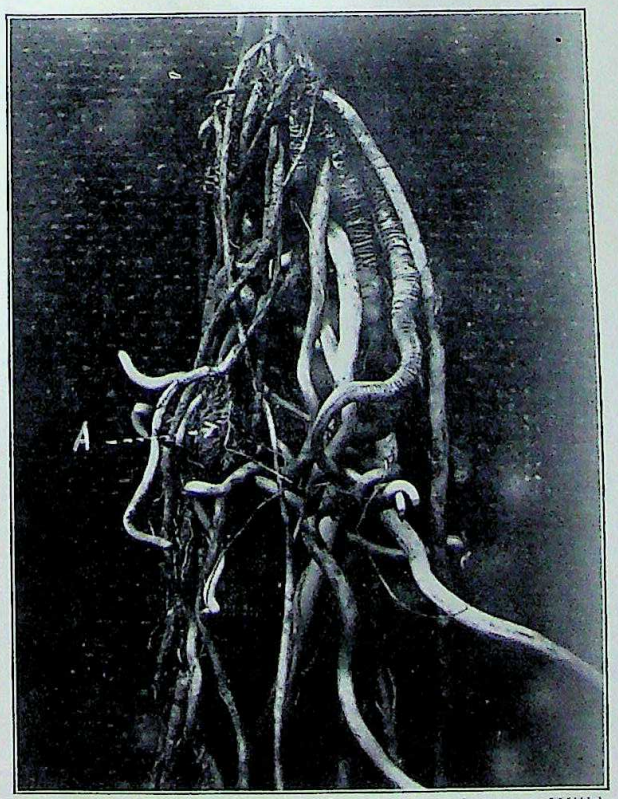


1. Root system of *Nymphaea pubescens* Willd., normal roots (left); abnormal roots (right). (Note small 'tuber'.)



2. Abnormal root system of *Nymphaea pubescens* Willd., showing wrinkled roots. (Note small tuber at A.)

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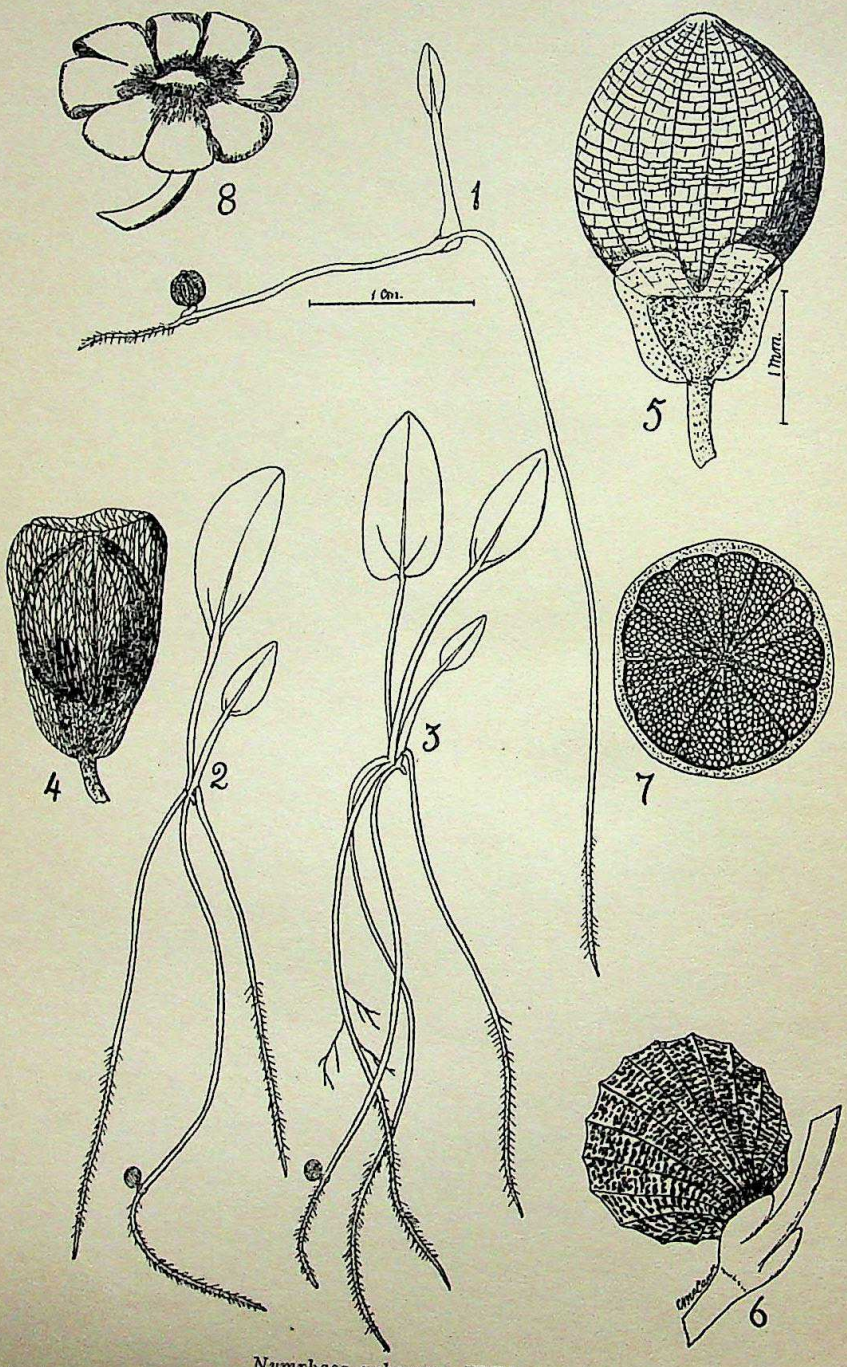

Nymphaea pubescens Willd.

1. A seedling with the first leaf. 2 & 3. Further stages of the seedling. 4. Seed within afil. 5. Seed with partially developed aril. 6. Portion of germinated seed. 7. Section of fruit showing septa. 8. Dehisced fruit showing recurved segments.

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there were still two or three attached. When rhizomes are imbedded in slush, hastate, sagittate or linear leaves are produced till the ground dries up, when all vegetative growth is arrested. The rhizome is surrounded by a protective covering of long silky hairs sometimes interspersed with scale-like appendages which, in my opinion, are the remains of the wings of the petioles.

Roots : The roots of *N. pubescens* are adventitious. A fresh crop is produced each season in plants which are in tanks that dry up, but when in perennial water, new roots continually sprout. D'Almeida (l.c.) writes, 'Associated with each leaf-base are usually two roots, sometimes one, rarely three'. I have observed that at the base of each petiole there are generally three roots produced (Text-fig. 1, D), of which one, two, or all, may develop equally at the same time. However, this point often varies with different individuals. These roots are stout and spongy, and form the main root system [Pl. I, fig. 1 (left)]. Each one may reach a yard, rarely more, in length. At first they are greyish white becoming eventually white or sometimes stained russet. The extremity of these roots is protected by a well-developed, yellowish root-cap. After these roots have entered the substratum they develop numerous, lateral, filamentous, branching roots; but the main roots themselves never branch.

D'Almeida (l.c.) under the subheading of roots writes: 'Ordinarily the roots serve to anchor the rhizome to the soil and absorb nutriment therefrom. But occasionally some roots function as *pull-roots* and by their contraction bring about a firmer anchoring of the plant in the mud and thus prevent the rhizome (which we have seen is not buried in the mud but merely held down to the surface of the earth by its roots) from being swayed about by the movements of the water. . . They can be recognised at once by their transverse wrinkling.' After examining several dozen specimens during the vegetative period, I am forced to the conclusion that such 'pull-roots' (*sensu stricto*) do not exist in *N. pubescens*, and that the wrinkled roots [Pl. I, fig. 1 (right) & fig. 2] occasionally found, result from the roots meeting with firm resistance, and being thus confined within a circumscribed area. When growing in soft mud the roots are all straight and long without any wrinkles. The roots spread out in all directions near the surface of the substratum. But, should the roots meet with resistance or grow in a pot-hole, or the like, they tend to form spirals, and many of them become very decidedly wrinkled. A point about these roots is that they are much firmer in consistency than roots that are able to spread out. In all cases I have carefully examined the substratum before removing the plants. This I have done by means of a stick, and also by going under water when necessary.

Leaves : The size, texture and shape of the leaves are dependent on the size of the rhizome, on the amount of moisture and water present, and on whether the apex of the rhizome is submerged or not at the time when the leaves are developed. The seed at first develops a single small broadly lanceolate leaf (Plate II, fig. 1). This is soon followed by larger membraneous submerged leaves which eventually form a rosette. The margins are entire,

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the upper surface pale green, the underside is a paler glaucous green rarely tinged with purple. Young plants have small leaves on thin petioles. Old rhizomes, which are partially submerged or

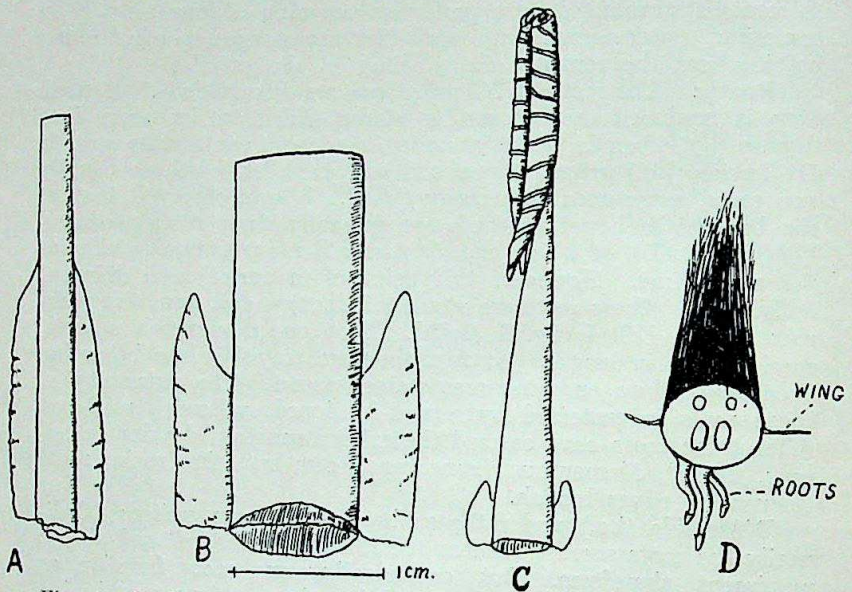

Fig. 1.—A. Wings of petiole in young plant. B. Wings of petiole of old plant. C. Wings of a young leaf of an old plant. D. Section of petiole showing wings, roots and 'hairy' stipule (Diagrammatic).

in damp soil during the hot weather, produce erect, short petioled, hastate, sagittate, or linear leaves above the surface of the water, or if submerged, near and above the surface. These are really the 'dry season' leaves which appear just before the plants aestivate, and not during the monsoon. Whether such leaves would be produced under artificial conditions at any season, I am unable to say. These 'dry season' leaves are uniform in colour on both surfaces, unlike the floating 'monsoon' leaves which are purplish beneath. Again, the margins of the 'dry season' leaves are usually entire. In texture they are more or less membraneous. Plants in deep water throughout the year, produce the regular floating 'monsoon' leaves. During the monsoon which is the true vegetative period of *Nymphaea*, the floating leaves are produced on long, almost cylindric petioles, the length of which depends on the depth of water the plants happen to be growing in, or upon the available space for their even distribution on the surface of the water. At the base of the petioles there are usually two linear-oblong wings adnate by their inner margins to the petiole for the greater part of their length (Text-fig. 1, B & C), the upper portions alone being free and ending in acute or subacute tips. These wings separate from the petiole when the latter increases in diameter, and often remain as 'scales' attached to the rhizome, or fall away entirely. Thus it is that many of the older leaves appear

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wingless. D'Almeida in regard to the wings (stipules) of the petioles says: 'In the early juvenile form of the leaves the stipules are absent, but in the later ones they occur as slight lateral wings of the base of the petiole.' I have observed that these wings are present throughout, but to a varying degree according to the age of the plants. In all young plants the wings to the petiole are generally narrow and adnate to the petiole throughout their entire length (Text-fig. 1, A), whereas in the leaves of older plants, the wings are free above from a very early stage.

Partially surrounding the base of each petiole is a fringe of fine long, white, silky hairs (when dry) (Text-fig. 1, D). In young leaves these hairs are so united as to appear like membraneous adaxial stipules (as which I regard them). On 'dry' rhizome these hairy appendages form the fluffy protective covering. These 'membraneous' appendages are, in my opinion, really adaxial stipules transformed to serve a dual purpose. Occasionally such a transformation from a membraneous to a fimbriate appendage is seen in the development of the ligules of some of the *Gramineae*.

Flowers : *N. pubescens* commences to flower about mid-July and continues to do so as long as there is sufficient water. During the dry season flowers are scarce even in perennial water. The size of the flowers is, I believe, in proportion to that of the rhizome —the oldest rhizomes producing the largest flowers, as already indicated. The peduncles, like the petioles, vary in length with the depth of water. There are no membraneous wings at the base of the peduncles. The flowers are partially nocturnal and partially diurnal. At about 7 p.m. they commence to open and remain open all night, closing next day about noon or a little before.

Fruit : After fertilisation the flowers do not open again, and no longer stand erect on their peduncles out of the water. Henceforth the young fruit gradually sinks as it matures, and generally remains just below the surface of the water till ripe when it rises to the surface once more. After fertilisation, the petals are the first segments of the perianth to decompose and fall away. During this time the sepals usually become green and foliaceous, but they too soon fall away. The broad filaments of the anthers are yellow in the fresh flowers; but now they undergo a remarkable change. They gradually lose their yellow colour, increase in width and thickness, turn green, and lose the upper portion which supported the anthers. In this condition the filaments remain as a persistent crown to the fruit. The outermost are the largest, diminishing in size towards the centre. The outer frequently show lines of 'union' on the outside of the fruit giving the appearance as though the carpels of the fruit were composed of fused filaments. The extremities of the outer rings of enlarged filaments are usually recurved, while those of the inner ones are incurved. Eventually the outer coat of the fruit splits more or less regularly into 8-10 segments which become strongly reflexed (Pl. II, fig. 8) the apical 'corona' of filaments coming away in the form of a disc. The seeds float for some time and are blown about by the wind.

The fruit is globose, internally divided by 12 radial septa to which the seeds are attached by short stalks (Pl. II, fig. 7).

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Seeds: The seeds are numerous, 2 mm. (excluding the aril), rotund, slightly umbonate, 14-16 longitudinal ribs, trabeculate (when young) becoming mottled with age (Pl. II, fig. 5); reddish brown or brick red in the indehisced fruit, becoming green when they leave the aril and eventually mottled with brown when old. Each seed is contained in a transparent funnel-shaped aril (Pl. II, fig. 4) which on contact with the water swells considerably, finally becoming mucilaginous. The aril is marked with fine reticulations. When the arils swell to their fullest the seeds drop through the mouth of the 'funnel' and sink to the bottom. The aril acts as a float.

Habitat: *N. pubescens* is commonly found in all the still waters of the Bombay Presidency, often associated with other members of the same genus, *Limnanthemum* spp., *Potamogeton* spp., *Pseudoraphis aspera* Pilger, and many other aquatic and marsh plants.

Development of the Seedling.

The seeds when liberated from the fruit are generally blown towards the bank when they fall away from the arils and sink to the bottom. If the water does not dry up too rapidly, there is no long period of rest and the seeds soon germinate in the shallows; but should the water dry, the seeds do not germinate till the next monsoon.

On germination the seed produces a single radicle and two small cotyledons between which arises a short or long stolon-like process at the extremity of which is developed a single small broadly lanceolate leaf and a single adventitious root (Pl. II, fig. 1). The first leaf is soon followed by another larger and broader one and so on till a small rosette is formed (Pl. II, figs. 2 & 3). Accompanying each leaf is a root at its base. At the point where the first leaf is developed a small rhizome is produced. In the following period of activity a fresh rosette of leaves is formed. These leaves are followed by small floating leaves year by year till the plants reach maturity. The seed-coat persists for a considerable time before it falls away to be washed up at the break of the next rains. In this condition large quantities of shells may be seen floating about.

Dispersal.

Seed: The dispersal of seed may be attributed to many agencies. Wallowing animals undoubtedly carry away numerous seeds adhering to their bodies. The buffalo, for example, would be an excellent dispersing agent in India. It wallows in the rapidly drying boggy beds of tanks and pools—just at the time when all the seeds are mature. Aquatic birds probably account for a large number conveyed in the small clots of earth sticking to their feet and feathers. Water is another excellent carrier of seed.

Rhizomes: Apart from the rôle water plays in the dispersal of the seeds, at the time of floods, rhizomes and even entire plants

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are washed away to great distances from the place of their origin. Finally whether accidentally or deliberately, Man is responsible for the transportation of seeds and rhizomes; as for instance when large quantities of earth are carried long distances off.

Summary.

There still remains much to be studied with regard to the life history of *N. pubescens*. The few points touched on in this paper are the result of field observations made over a period of several years in the Bombay Presidency, chiefly in the Islands of Bombay and Salsette, where this species is extremely abundant. In situations which dry up soon after the rains the plant presents two almost distinct phases: (*a*) the 'monsoon' or true vegetative phase; (*b*) the 'dry season' or quiescent phase—at times one gradually passing into the other.

Normally the rhizomes are vertically imbedded in the soil, but they may occur only anchored to the substratum by roots—depending on circumstances. The rhizome often produces secondary 'tubers'. The dead rhizomes generally leave the substratum due to the formation of gases within their woody outer layers, and float to the surface. This is frequently observed also in 'free' active rhizomes which have their lower extremity in a state of decomposition.

The leaves vary in shape, size and texture according to the seasons and according to the age of the plant. All roots are of the absorbent type, and only become coiled and wrinkled as a result of resistance or confinement within a circumscribed area, giving them the appearance of *pull roots*.

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NOTES ON THE HABITS OF SOME INDIAN BIRDS.

BY

CAPTAIN R. S. P. BATES, M.B.O.U.

(*With three plates*).

In *Nidification of Birds of the Indian Empire*, vol. ii, p. 76, is a reference to Whymper's record of a nest of *Rhyacornis fuliginosa fuliginosa*, the Himalayan Plumbeous Redstart, built in a tree. Undoubtedly holes in banks and walls, and natural hollows in trees overhanging, or close to, the water provide the usual sites for these nests, but I can add three records of conventionally shaped ones built in forks of trees. The first, which was empty, was on the Madmatti River, near Bandipur, Kashmir, in the crown of a pollarded willow; date May 25, 1920. Moss and leaves formed the bulk of this nest. The second was in a fairly well concealed upright fork of a low willow on the bank of the same river about two miles further upstream; elevation approximately 5,500 ft. and date May 27, 1921. It was made mainly of moss lined with hair and thin grass, was about the size of a Hedge-Sparrow's nest, and contained four hard set eggs. The third and last was also in a fork of a willow tree on the landward side of a thick hedge a few yards from the Lidar River near Pahlgam Village (6,800 ft.). It might well have been that of a Hedge Sparrow, being substantially built of moss and a few leaves with a wool and hair lining. On May 31, 1932 it contained large young ones.

Incidentally nests are occasionally some distance from water. In addition to the one I found in 1921 fifty yards from the river at Lidarwat, two years ago I came across one at Tanin about the same distance up a steep slope overlooking the Astanmarg stream. It was in a hollow of a fallen tree. I put down the reflex camera while I looked at it. My spaniel came rushing up the hillside, bumped into the case and sent it spinning down into the torrent below. Fortunately it came to rest in shallow water. The only damage was a broken plate-holder!

At Lidarwat, late in July 1928, I came upon three very curiously placed nests, none of which, I might add, survived for any length of time. Crossing a tumbled down fence by the pathside I almost put my hand into a nest wedged into a slight recess at the top of a post. Another was in a slight indentation in the side of a gently sloping grassy bank, the sort of situation a Lark might choose, while the third was two feet from the ground stuck against the trunk of a pine tree by the water's edge. Someone had taken a chip out of the bark with an axe, the resultant depression accommodating about one third of the nest.

I see Buchanan and Whymper are quoted as finding cup-shaped nests of *Calliope pectoralis pectoralis*, the Himalayan Ruby-throat (*Nidification*, vol. ii, p. 82), but did Buchanan really mean cup-shaped without the semblance of a dome? Every nest I have

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Grey-headed Thrush (*Turdus rubrocanus*) approaching nest. Pahlgam 7,000′, Lidar Valley, Kashmir.

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Nest of Blue-headed Rock Thrush (*Monticola cinclorhyncha*), made largely of pine needles. Pahlgam 7,000′, Lidar Valley, Kashmir. *S. P. Bales.*

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ever seen I would certainly describe as domed, but semi-domed would apply equally as well. Cup shaped would apply to none. The entrance is decidedly on the large side taking into account the proportions of the nest, and is situated towards the top, thus displacing the better part of half the dome, but the structure still inclines towards the shape of a coconut with a piece cut out of it.

And what does Mr. Stuart Baker mean when he says their nests are always in the open? On open ground above the tree-line —yes, but a most favoured situation is in the roots of juniper where it grows in patches on the hillsides. Usually the nest is near the outer edge of its patch where the scrub is but one or two feet high. So far I have not been lucky enough to find a nest in any other situation, and nests in grass tufts on open hillsides have never come my way. This may of course account for my never having found a cup shaped affair.

On the subject of the Western Grey-headed Thrush (*Turdus rubrocanus rubrocanus*) I feel I could really spread myself, but I will restrain myself as far as possible. The somewhat limited information in Hume's *Nests and Eggs* infers that nests are only to be found in banks. It seems to me that subsequently, taking this for granted, collectors, including myself, have hunted about at ground level, and with occasional success. Stuart Baker (*Nidification*, vol. ii, p. 119) has therefore been compelled to carry on the tradition, adding a note of Rattray's of a nest in a hole of a tree trunk up to ten or twelve feet from the ground, and that I found them building their nests in hollows in decayed stumps and considered such places were more often used than banks. This certainly was my impression until circumstances forced me to look elsewhere with immediate and most fruitful results.

Pahlgam was the scene of my enlightenment. Those who have visited that delightful spot will remember the shady path which leads through the extensive pine and mixed forests passing just above the little church to Rainspal Marg and on up the left bank of the East Lidar River.

On May 17 on the very edge of this path I found an empty nest built at eye-level on a couple of small horizontal branches and close up against the trunk of a pine tree. It looked uncommonly like a thrush's nest.

The following day while forcing my way through a little copse of young pines in a wood on the right bank of the West Lidar River, a bird fluttered out of the crown of one of the young trees, disclosing a nest about eight feet from the ground well concealed amongst the twigs. This contained three naked young but alas I had hardly seen the owner. As a lynx-eyed Jungle Crow was becoming unpleasantly curious, I beat a hasty retreat, but next morning watched a Grey-headed Thrush on to the nest.

My suspicions were now aroused as on the 19th I saw no less than three pairs of these birds while walking along the Rainspal path, and to quote from my diary for that day 'One had a nest well-concealed about nine feet up in the crown of a fir sapling. It contained one young one about a week old, so the egg or eggs

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must have been laid in the latter half of April. I did not realise that this bird was so common at only 7,000 ft., nor that it bred so early'.

Further extracts from my diary will complete the story. 'May 20.—Went up to Baisaran. Found a number of old or empty Grey-headed Thrush's nests in tree forks about six or eight feet from the ground. At length we found a lately deserted one at the top of the hill (8,000 ft.) with three somewhat bad eggs in it which I took. As if to show that the exception proves the rule, the nest was in the roots of a hazel only a few inches off the ground.'

'May 22.—Spent the morning in the woods on the left bank of the East Lidar. Within fifty yards of the Grey-headed Thrush's with one young one, found the following:—Another Thrush's with three eggs six feet up in the fork of a hazel; a Blue-throated Fly-catcher's being built. . . . Eventually I found two more Thrushes' against pine trunks, one five and one ten feet from the ground, the former with three eggs and the other with two new young and an egg. Also found two new but empty ones in same kind of site and a number of old ones.'

'May 26.—Found yet another Grey-headed Thrush's nest with the bird sitting on two eggs. Usual situation (six feet up in fork of hazel).'

'June 5.—Another Grey-headed Thrush's in the same old wood well-concealed against the trunk of a fir on the path-side. It is only five feet from the ground, contains three incubated eggs, and in an excellent position for photography.'

Between May 17 and June 5, I therefore found no less than eight nests containing eggs or young and at least an equal number of old ones and new ones being built. Out of these only one was near ground level, the remainder being against tree trunks, usually where a couple of horizontal branches sprang out together, and to a lesser extent in forks, varying from five to twelve feet from the ground. Some were very well-concealed, many far from it, but once having realised that far more nests were to be found off the ground than on it, I simply could not help discovering them. In character I found these birds very close sitters, though extremely wary in returning to nests containing eggs. They become bold and very fussy after the appearance of the young.

Of the Blue-headed Rock-Thrush (*Monticola cinclorhyncha*) in *Nidification*, vol. ii, p. 150, Stuart Baker writes as follows: 'Hume also notes that they sometimes incorporate pine needles in their nests but, though all my nests have been taken in pine wood country, I have seen no pine needles used, nor have I ever seen the birds breeding inside these woods, although they may be all round them.'

Near Pahlgam I know of a certain pine wood roughly quarter of a mile square. Through this wood runs a small but ever-deepening nullah, the pines growing down its sides. One or two channels, mere depressions forming sloping banks but two or three feet deep, run through the wood into the nullah. As is

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usual in pine woods undergrowth is conspicuous by its almost complete absence, though a few scattered brambles occur here and there along the nullah.

On June 5, when some thirty yards inside the wood at a point where the nullah was perhaps some fifteen feet deep with fairly steep banks, my wife's spaniel pushed his head into the base of one of the few bushes, whereupon a female Blue-headed Rock-Thrush burst out from under his very nose. So close had she sat that he could easily have caught her, but her flustered exit so startled him that all he achieved was to push a small twig through one of the four fresh eggs which the nest contained. Although so startled the bird made no sound and flew straight down the nullah till lost to view. The nest was composed almost wholly of pine needles with a few short lengths of quite stout twigs incorporated on the outside. I removed the broken egg and tidied up the nest but alas she deserted, as next day only one egg remained and this was quite cold.

Ten days later, hoping that this pair, which were still hanging about, might be nesting again I thoroughly searched every likely spot I could find in the wood. I traced no occupied nest but found two disused ones under the buttress roots of pines growing on the edge of one of the shallow channels. One of these was almost wholly made of needles; the other lined with them.

In 1931, on July 1, I stumbled on a nest of this bird when crossing the Hayan Pass on our way back to Srinagar from the Sind Valley. The surroundings of the nest were as follows:— Elevation about 9,000 ft. The bridle path we were on ran diagonally upwards across a steep slope. Above the path the pines grew thickly; below it the fall of the ground steepened and pines and other trees were somewhat scarcer. The nest was in a hollow formed by a sloping stone projecting from the bank on the inner side of the path. Its lining was of pine needles, the rest of the structure being of a little moss and some stout twigs with two or three really large pieces of bark buttressing up the front. It contained four eggs on the point of hatching.

Of its habits Stuart Baker states that he has always found both male and female shy during the breeding season, very loth to visit the nest when watched, and leaving it before an intruder approaches the nest very close. He does however go on to quote that Marshall and Cock found it otherwise. Personally I have found it an exceptionally close sitter. For instance in the case of the Hayan Pass nest the female only left when my boot—I was riding—literally brushed past the front of the nest. On another occasion I stood over a sitting bird for some minutes talking to the shikari who had spotted her, while as stated my dog nearly caught one though the nest contained fresh eggs. Once flushed, it is another matter. I have always found it to leave the nest with a swift direct flight, usually straight downhill, and to pass completely from view without uttering a sound. As regards approaching the nest when watched, Stuart Baker is undoubtedly correct. I have waited in vain for hours. And my only attempt at photographing one at the nest likewise ended in failure. Half

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an hour after entering the hide, the female descended to the edge of the nest, but hearing a slight sound from within, she left immediately and never appeared again although I waited the whole morning.

What is the incubation period of the Himalayan Whistling Thrush's egg? On May 18, I found a nest containing one fresh egg. By the 21st it held its full complement of four; that is, an egg had been deposited each day. Unfortunately I did not visit this nest again until June 9 when to my surprise I found four healthy naked young ones so large that they filled the nest cavity entirely. I judged them to be at least four to five days old, which places the incubation period in the neighbourhood of 14 days. This is shorter than I had expected it to be, but it is perhaps offset by the fact that the young ones remain in the nest a considerable time.

This note refers to Bareilly in the United Provinces. On July 21, 1932, I noticed a very busy little Tailor-bird (*Orthotomus sutorius sutorius*) making frequent visits to a small mango tree bordering a lawn. By August 2nd the female was sitting on eggs in a decidedly well concealed nest built within three drooping leaves carefully stitched together. It was a good nest for observation purposes being but six feet from the ground, but alas on the 7th I found it empty and slightly depressed on one side, as if a somewhat heavy creature had stood upon its rim.

Two days later I found that they must have immediately turned their attention to a croton on the verandah and here a new nest very rapidly appeared. Although decidedly conspicuous, and within six feet of where my bearer sat every morning cleaning my gear, this nest survived and a brood was successfully reared. I cannot say which bird was responsible for sewing the leaves together but I noticed that both helped with the construction of the nest within. Building activities ceased on the 11th and an egg was deposited on each of the three following days (I looked in at approximately 10 a.m. every day).

The female did not wait for the deposition of the full clutch, but commenced sitting on the 13th when the nest held two eggs. On the 25th at 10 a.m. I saw the female fly off with a piece of egg-shell in her bill and found that one egg had hatched out and that another egg was cracked. This had also hatched off by mid-day. As I expected the third young one appeared the following morning. The period of incubation was therefore 12 days.

When we went up to Pahlgam in May 1932 I hoped for photographs of the handsome Black and Orange Grosbeak (*Perissospiza icteroides*). Photographs of a sort I did obtain but not in the manner I had expected. When exactly do these birds breed at this level (7,000 ft.)? Very early on I suspect.

On arrival, May 17, I noted a pair, male and female, in the vicinity of the church. Another pair, also male and female, used to haunt our camp and were in the habit of hopping up quite close to the tent in the early mornings and evenings to crack the

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pine seeds unearthed by our servants in their passage to and from the so-called kitchen. It was through this that I got a photograph of a male. We were having a lazy afternoon in the tent when my wife heard the faint cracking of seeds just the other side of the flap. Cautiously pushing out the lens of the reflex, I found the image of a male Grosbeak taking up the whole of the focussing screen. Alas at that moment I had no sufficiently colour sensitive plate available, so the resultant photograph might well be of his dull coloured consort.

Towards the end of the month the female disappeared, but two males kept up the practice.

On June 4, I found myself constrained to write in my diary 'Have seen numbers of male Grosbeaks together the last few days'.

On the 9th, I wrote: 'In the afternoon two male Grosbeaks came to the tent. I took one through the window. One sees no females about now but the males are not alone and sometimes in flocks of four or five.' Where were the females?

Soon after this we moved to Tanin (9,000 ft.). Unfortunately I failed to keep a clear record of the Grosbeaks there. On June 24 I noted 'Saw a flock of at least half a dozen Grosbeaks'. Sex I did not state and I cannot now remember whether this refers to a roosting party which I disturbed late one evening. Coming down a steep hillside when the light was rapidly fading, I threw a stone into a patch of thick bushes about eight or ten feet high. To my surprise the place at once became alive with fluttering birds which dashed out on the lower side of the clump. Going quietly round I got my wife to throw in a couple more stones when out came more birds, those close enough to me to be recognised in the bad light turning out to be about half a dozen Grosbeaks. From their size and flight I think it more than likely that every one of the birds which came out was of this species. If so they must have collected from a wide area to roost together in the security of these thick bushes on this somewhat open hillside. Incidentally there were pine woods in plenty on both sides and above, the nearest real wood being about three hundred yards distant.

The Red-browed Finch (*Callacanthis burtoni*) is a most intriguing bird. Very little seems to be known of its nesting. In fact the few records extant are somewhat vague. It is by no means an uncommon bird, so how it has succeeded in maintaining its secret is somewhat of a mystery. It certainly breeds around Sonamarg (approximately 9,000 ft.) in May and June. On June 12, I found myself literally face to face with a young bird so uncertain of its wing power that I almost caught it before it fluttered off its perch, while a pair certainly had a nest in the vicinity of some isolated pine trees near the mouth of Glacier Valley. I watched this pair frequently up to June 20, but any amount of searching failed to disclose a nest though just as we were leaving Sonamarg on that date I disturbed them feeding two young ones on the ground near these same pines.

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When feeding they are really quite tame. I have often come upon parties feeding on the ground which have only flown up into the nearby bushes or trees, uttering soft 'tews', when I have been right amongst them, and almost before I have got twenty yards away they have commenced dropping down again in ones and twos to the same spot. When disturbed like this, they always seem to fly up onto the nearest eminence, be it a tree or a stump but two feet high, and here they remain sitting quietly until the disturbing element has passed.

Last year I came across an excellent example of the necessity of not allowing enthusiasm to lead one into reporting supposed discoveries without making the most careful investigation into their authenticity. On June 8, I found myself looking into a Monal's (*Lophophorus impejanus*) nest with no less than eight eggs in it. It will be remembered that in *Nests and Eggs*, vol. iii, p. 408, Hume quotes Major Cock who writes of clutches of from five to eight in number. In his *Game Birds*, vol. iii, Stuart Baker discounts these reports, pointing out that recent collectors have never found more than six eggs in a nest and that only rarely. I was recently sent a beautiful photograph of a nest of six eggs by Mr. E. H. N. Lowther. About his nest there is of course no doubt as he found it himself, but my clutch of eight eggs provides a very different story.

On June 7, I had met a local shikari at a log bridge over the East Lidar a couple of miles above Pahlgam. He wanted me to shoot a bear, but when I said I only shot birds and their nests with a camera, he volunteered the information that he had just seen a Monal on its nest on the steep wooded hillside whence he had obviously come.

I went out with him the very next morning and attempted to photograph the bird on the nest. It was in a hollow under a small fir seedling at the top of some steep rocks by the edge of a log shoot, an impossible place for a hiding tent. All I could do was to rig up the half-plate camera within three feet of the sitting bird. In order to focus I had to lean out over a twenty-foot drop, holding on to the shikari, who in turn was grasping a tree trunk. Having got the focussing done, I then had to clear grass and some dead twigs out of the line of sight. Her Majesty submitted to this turmoil without the flicker of an eyelid, so after quarter of an hour's hard work I thought I would succeed. But pride comes before a fall. An irritating twig, the very last obstacle, was right across her face. An attempt to move it was followed by a whirr of wings and away she sailed down the hillside, swerving shortly into the cover on the left of the shoot.

Of the eight eggs one was very much matted with dirty down. The nest too was by no means clean, containing amongst other debris three large beetles which had evidently been sheltering under her warm breast.

I suggested to the shikari that I should make a further attempt the following day, whereupon he told me that he had received orders to take the eggs and send them down at once under a

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Copyright Sarus Crane (*Antigone antigone*, Linn.) at nest. Bareilly, United Provinces. *R. S. P. Bates.*

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Nest and eggs of the Sarus Crane (*Antigone antigone*, Linn.) near Bareilly, United Provinces.

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hen to the authorities in Srinagar where I gathered the young birds would be placed in an aviary.

After due cogitation I felt there was something fishy about this story, as the man was only a local shikari and not one of the official game watchers. On my return to the plains I therefore wrote to the Game Department in Srinagar asking whether, in view of the fact that I was very interested in the discovery of a nest of eight Monal eggs, they would be kind enough to tell me whether the young birds had all hatched out and at what intervals. The reply was enlightening to say the least of it. No instructions whatsoever had been issued regarding this nest. After giving the Department further information, I received a final reply to the effect that the eggs had indeed been sent to Srinagar but to no State Department, implying that the shikari had been indulging in some underhand trading, that the young birds had all died, and that there was good reason to suspect that the eggs were not the product of one hen. The last bit is of course what I had suspected. For his own convenience the shikari had probably put the eggs from a second nest into the one he showed to me.

I have related this story at length to show that it is not safe to trust even one's own eyes in the case of a nest which has been previously found by some worthy who is likely to put personal gain before scientific accuracy. I don't know whether Major Cock employed native collectors (who are so very often unreliable, being more mindful of increased kudos, and bakshish, for discoveries, than of the necessity for the strictest veracity where science is concerned), but this is perhaps the true explanation of these reputed clutches of nine eggs.

In spite of the fact that the Sarus Crane (*Antigone antigone antigone*) is very common around Bareilly in the United Provinces, I found it most difficult to hit upon a nest which promised any chance of successful photography, but in my search for the ideal I remarked many interesting incidents. On August 9 for instance I spent some profitable minutes observing nest building. The pair in question were both hard at it well out in a shallow swamp. One bird remained building up the nest while the other worked round it in a circle, pulling up the reeds and throwing them in the direction of the nest over its left shoulder in one sweeping motion. It worked decidedly fast, averaging round about twenty-five pulls to the minute. I watched them for perhaps twenty minutes. They then broke off and, wandering away together, commenced feeding.

On August 14, not so very far from this same nest, I thought I spotted a Crane's neck protruding above the rice stalks a good half mile from the road I was on. The glasses confirmed my suspicions. As it was obviously a sitting bird I went to investigate. The very moment I left the road the neck disappeared. Fortunately I had marked the place fairly accurately otherwise I might quite easily have missed the nest. She let me walk past her some thirty yards away without moving. Out of the corner of my eye I saw her lying flat in the nest with head and neck laid

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along the ground straight to her front. It was really most surprising to find how inconspicuous, one might almost say insignificant, this huge bird had become. The nest was merely a circular mound of hardened mud roughly eight feet across, with about half a pound of dried rice-stalks round the edge of the shallow glazed mud central portion containing a single egg. The mound had in all probability been formed from the accumulations of some years of nests.

On August 20, I at last found a nest containing two eggs so placed that the receding waters in the depression in which it had been built had laid bare a patch of mud of sufficiently substantial consistency to enable me to erect the hiding tent at a convenient distance from the nest without fear of coming to a sticky, not to mention a slimy, end. This depression, surrounded on two sides by sugarcane and bordering a weedy tank behind the Sadar bazaar, was usually a rice field, but abnormal rain had filled it up to the very edge of the cane-brakes. Some thirty yards out was a slight hump just under water, a continuation of the muddy spit on which I was eventually on August 26 able to erect the tent. According to my usual practice I put it up late that evening.

In order to have the sun in the right direction and as it was still very hot, I got into the hide at 7 a.m. the next morning. Although there had been no signs of either bird I had only a short time to wait before one of them put in an appearance. Approaching in the usual stately crane manner she stood for a few moments by the nest eyeing the hide, but soon came to the conclusion that it was quite harmless. Mounting the nest, she placed her feet slightly behind the eggs and, lowering her long neck, gently rearranged them with the tip of her bill. She then sank down, ever so slowly—in real cinema slow motion as it were. This action brought her so far back in the nest that it looked as if she would miss the eggs altogether. Naturally she didn't, but they were only just out of sight covered by her breast feathers.

She seemed quite content, sitting with head erect, but within five minutes she stood up, had a good shake, and puffed out all her body feathers until she looked like a thoroughly overgrown powder puff. At this moment a very much moulting Whiskered Tern alighted between the nest and the hide but so close that I had to stop the lens right down to get both birds in focus. Fortunately they had the decency to remain quite motionless while I gave a time exposure. I nearly repeated the performance with a Pheasant-tailed Jacana but it moved out of the field just too soon.

Quarter of an hour after the Sarus had once more composed herself on the nest, I heard a loud trumpet from the direction of Chanehti village. My victim at once took notice, gave forth two terrific blasts in return, and stalked off the nest out of sight to my right. A moment later I heard the powerful beat of her great wings, then all was silence.

For how long was the nest to be left unguarded? I was just

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wondering when both Saruses walked calmly into view. Alas they were as like as two peas. I had hoped there might be some distinguishing mark by which I could find out whether both or only one parent incubated the eggs, but there was no way whatsoever of telling the one from the other. I have talked all through of the sitting bird as 'she', but perhaps it is quite wrong of me to have done so.

I had at this time another pair under observation but they alas steadfastly refused to nest. One of these was perceptibly smaller than its mate, had a much wider pale band round the neck, and a definitely higher pitched voice.

I took a further number of photographs of both my birds at the nest but the incubation problem remained unsolved. Unfortunately further work at this nest was summarily cut short. The same afternoon heavy rain set in. Next morning the nest was not to be seen—it was a foot or more under water, but wonder of wonders the Sarus was quite calmly incubating one surviving egg, which had been rescued by a villager and placed on a promontory projecting from a canebrake a hundred yards from the late-lamented nest. I never discovered what eventually transpired, but a couple of days afterwards the single egg too had gone, leaving a disconsolate pair of Cranes wandering about the fields of Chanehti.

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'AN INTERESTING CASE OF SEMI-CYCLOPIA IN A SHARK.'

BY

JOHN BERRY, M.A. (Cantab.).

From the Natural History Department, University College, (University of St. Andrew's), Dundee.

(*With two plates and one diagram*).

ACKNOWLEDGMENT.

Before dealing with this specimen, I should like first to acknowledge my indebtedness to those who have assisted me with valuable co-operation and help in the examination of the specimen.

Thanks are due, in the first instance, to Mr. C. Boden Kloss, Director of Museums, Straits Settlements and Federated Malay States, for sending the monster together with a normal specimen to University College, Dundee, for investigation. For allowing me to conduct the examination, and for technical advice I am greatly indebted to Professor A. D. Peacock, D.Sc., Natural History Department, and to Dr. G. R. Tudhope, Department of Pathology; also to Mr. A. T. Baxter who prepared the material for microscopical study.

University College, Dundee,
February 1931.

INTRODUCTORY REMARKS.

Obtained by the Raffles Museum, Singapore, from a shark in the local fish-market, this specimen was sent, preserved in formalin, to Professor Peacock at Dundee for examination. It was an example of *Charcharias Dussumieri* (Valenciennes), one of the 'true sharks' all of which are viviparous, and the genus is characterised by absence of spiracles, and dorso-ventral compression of the snout which is not greatly produced longitudinally.

In normal specimens, commencing with the anterior extremity of the rostrum and continuing posteriorly, the ethmoidal rods are more nearly coplanar than in most forms, being also rather shorter and stouter. The chondrocranium is strongly made, having a small anterior fontanelle, and being traversed dorsally by a well-marked longitudinal median depression which serves to mark the separation of the parencephalic lobes; but with other divisions of the brain, these suffered considerable dissectional rupture in preparation of the slides (Plate II, No. 1).

At this stage of development olfactory capsules are large, and olfactory epithelium well developed, since the embryos cannot

(*Note.*—Although written in 1931, this paper was mislaid and forgotten, hence the delay in publication.—J.B., 1934.)

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PLATE I.

SEMI-CYCLOPIA IN A SHARK.

A.—Head of normal shark.

B.—Head of monster.

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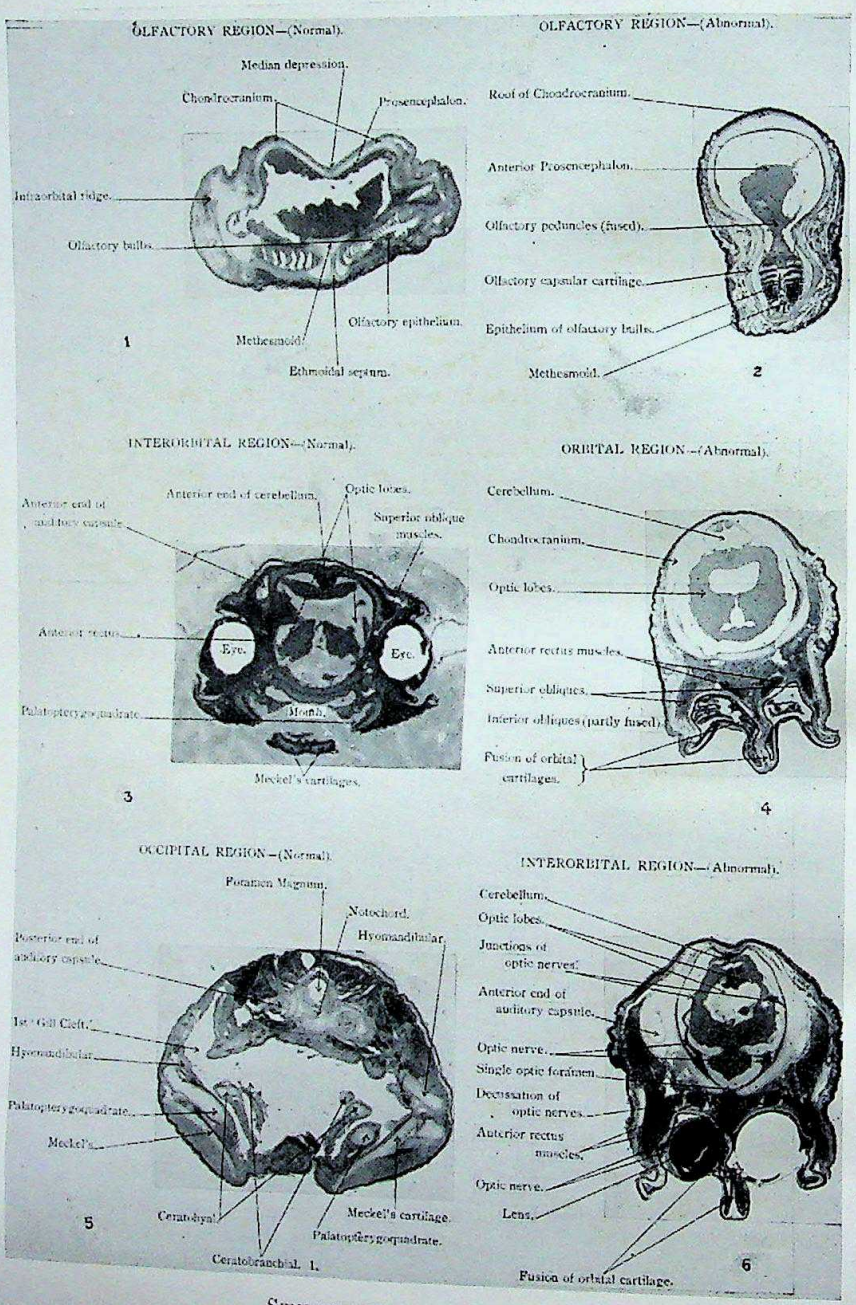

SEMI-CYCLOPIA IN A SHARK.
(For explanation see text.)

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have been far from birth when their parent was taken. Methesmoid and ethmoidal septum are strong and thick, which is of interest when this region (Pl. II, No. 1) is compared with corresponding parts of the monster (Pl. II, No. 2). Passing backwards towards the interorbital region (Pl. II, No. 3) palatopterygoquadrates are large but devoid of teeth, and the same is also the case with Meckel's cartilages. Unfortunately sections in this region are not as clear as one could wish and the facial nerves were hard to follow; however, in common with the optic nerves and muscles, they are typically elasmobranchian in character and distribution, and detailed description is therefore here superfluous. Auditory capsules are fully developed, and extend in both normal and monster from interorbital to occipital regions. The basihyal is narrow and strongly arched; the first ceratobranchials run upwards and 'overlap' the ceratohyals. Hyomandibulars are short, thick, and articulate at their proximal extremities with the auditory region of the cranium by means of the usual distinct articular facets; but since the monster is from here normally developed, further comparison between the two specimens is uncalled-for.

Abnormalities in the monster appeared to be confined to the anterior portion of the head; posterior to the mouth normality of development was soon evident, and since it was complete from the occipital region, detailed examination was consequently confined almost entirely to the fore and mid brain.

Photographs having first been taken of the monster and a normal specimen of similar age (Plate I), the heads of both were embedded in celloidin and slides prepared from transverse sections 'μ' in thickness, these having been first stained in Delafield's 'haematoxylin', and then counter-stained in Van Gieson's 'picro-saurefuschin'.

Some difficulty was occasioned by contortion of the heads causing apparent asymmetry to appear in the sections, but those selected for reproduction are but slightly affected.

Extent and Nature of Malformation in the Monster.

The rostrum of the monster shows profound malformation. The extremity of the snout consists of a vertical mucilaginous ridge compressed laterally, and immediately under this is a confused mass of cartilage caused by compression of the ethmoidal rods, which in turn are in close approximation to the olfactory capsule.

In the olfactory region (Plate II, No. 2), the head broadens rapidly, but 'depth' still remains considerably greater than 'breadth',—exactly the opposite of the corresponding region in the normal. Olfactory bulbs have undergone complete displacement in a downward direction, lie 'side by side', and even show partial fusion of the olfactory epithelium, especially at the posterior end of the olfactory capsule. Concurrently, methesmoid and ethmoidal septum have been forced downwards to the floor of the olfactory capsule where they form an irregular distorted bar, in places completely fused with the olfactory capsular cartilage. From the olfactory bulbs the olfactory peduncles rise almost

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vertically, and enter the true brain through the base of the prosencephalon; they are completely fused throughout.

Immediately posterior to the olfactory capsule come the orbits, which—at least externally—are the most striking aberrations which the monster exhibited. Hind, and even mid brains, are fundamentally normal, and although the foramina are unusual in position, the chondrocranium itself is not so far abnormal as to have caused constriction or malformation of any of the chief cranial regions. The orbits are directly ventral to the chondrocranium (Pl. II, No. 4), and so closely have they been compressed by their downward rotation that fusion of orbital cartilages has taken place along what normally would have been their ventral surfaces. In spite of this, however, the 'eye-balls' themselves are quite normal, but as is so often the case, toughness of the lens has caused such severe dissectional rupture that it is seldom possible to recognise all integral portions on the slides. Optic muscles have maintained a normal position relative to the orbits—the anterior rectus being vertically above the 'eye-ball', posterior rectus immediately behind it, and other muscles in equivalent positions on either side. Superior oblique and superior rectus muscles, being now external relative to the others, have undergone no important modifications, but inferior oblique and inferior rectus muscles are largely fused along the greater part of their lengths.

In the cranium, the cerebellum reaches its maximum dilation point slightly anterior to the vertical mid-line through the orbits, and below it the optic lobes, although showing slight downward lateral displacement, are otherwise normal (Pl. II, No. 4). But if the brain be called normal, the same cannot be said of the cranial nerves, and while the majority follow the malformations of the head exactly as would be expected, the optic nerves are so markedly unusual that they seem to call for particular mention.

In the extreme ventral ridge of the chondrocranium there is a single optic foramen (Pl. II, No. 6), and through this the *two* optic nerves—although closely compressed together they maintain their individuality throughout—enter the cranial cavity. There is no optic chiasma in the usual meaning of the term, but decussation of the optic fibres appears to take place at the point of entrance to the cranial cavity in the optic foramen itself. Thereafter the optic nerves run upwards round the inside of the chondrocranium and between that and the brain, to enter the optic lobes mid-laterally.

Posterior to the orbits comes the palatopterygoquadrate bar which has undergone considerable modification as would be expected. This has taken the form of downward, inward and backward compression which transforms these cartilages into a thick transverse block, while a corresponding modification of Meckel's cartilages (*see diagram*) has made of the normally strongly arched mouth practically a straight transverse slit (Plate I, A & B). Directly above the mouth are the auditory capsules which are perfectly normal except for negligible downward and lateral compression.

Visceral arches are all normal, but the basihyal has become

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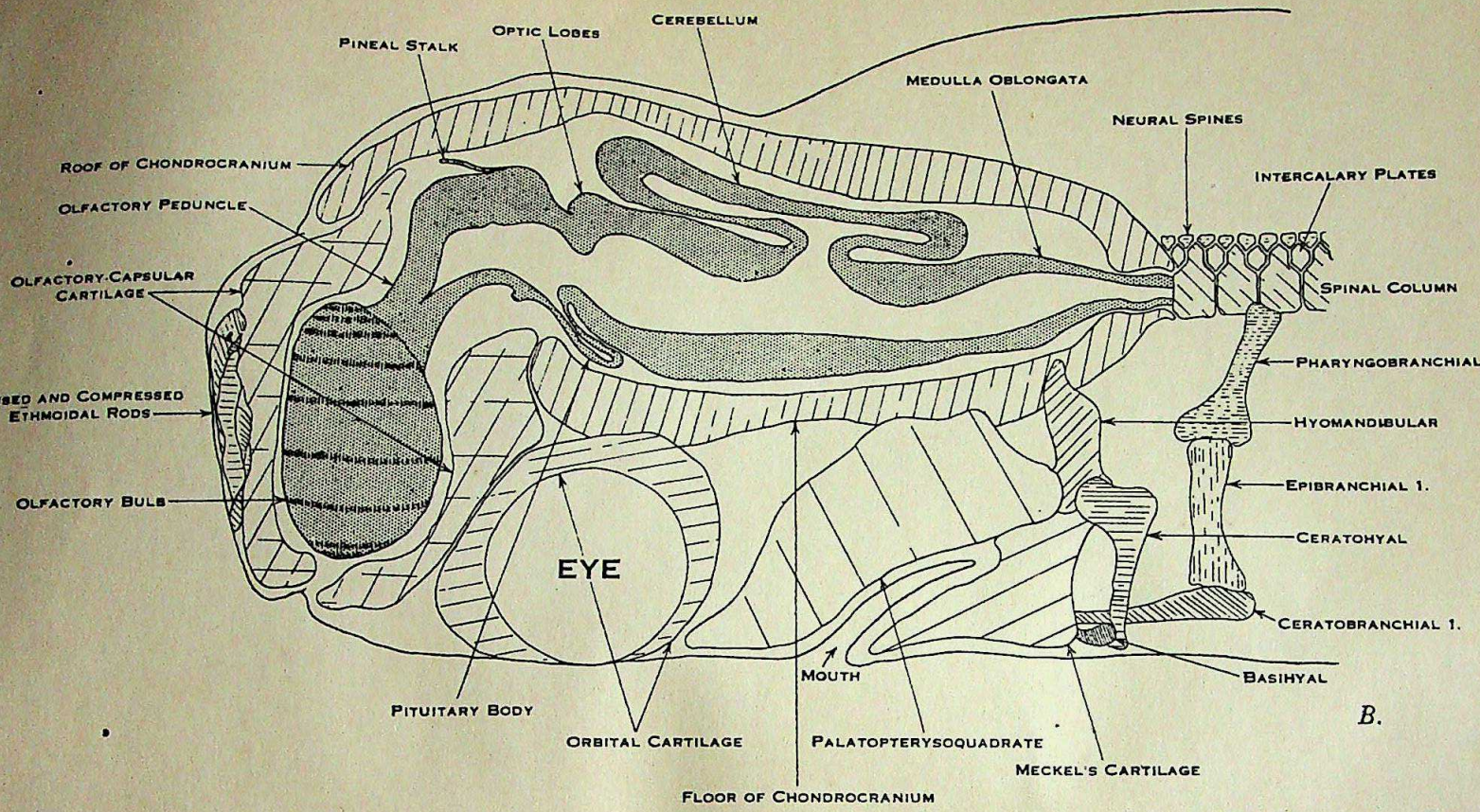

Diagram to show malformations of the head region.

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slightly more flattened transversely than is normal, and the hyomandibular is somewhat curved to conform to alteration in point of articulation of palatopterygoquadrates and Meckel's cartilages. As has already been stated, posterior to the occipital region the monster appears to be entirely normal.

Discussion.

Professor J. F. Gemmill[1] made two postulates in dealing with questions of teratological causation, first, that each recognised type of monstrosity could arise in a spontaneous or autogenetic manner by abrupt germinal variation, and second, that most recognised types could be produced by environmental factors acting during course of development; but he qualified the latter by saying that external factors were only causative in the sense that they could divert a course of development along certain fixed lines of which the limits were strictly governed by those potentialities which allowed for occurrence of the first or autogenetic type of abnormality.

Where monstrosity has arisen from abrupt germinal variation, abnormality of development, if it has not already commenced in the embryonic cranium, has at least become evident at so early a stage that the brain will exhibit the chief germinant irregularities, and to these such associated characteristics as reduction or fusion of optic lenses in cyclopia, for example, are merely secondary. If, however, origin of teratological condition be neither atavistic nor autogenetic, and assuming no pathogenic inception, it is only natural to expect that the brain, which is that portion of the head best shielded to withstand external stresses, will be least affected by mechanical results of adverse environmental conditions.

In the present instance, if consideration be given to the degree of developmental irregularity essential in production of malformations so profoundly and obviously abnormal, it is evident that compared with cranial conditions usually associated with cyclopia and allied monstrosities, the brain, and in fact the whole median and posterior chondrocranium, are singularly unaffected by whatever cause incited teratological aberration of rostrum and orbits.

Compressed and fused ethmoidal rods, together with signs of extreme external pressure on the olfactory capsular cartilage, together with comparative normality of the eye-contents compared to their position and fusion of the sclerotic cartilages, can leave but little doubt that the origin of partial cyclopia in this shark was a purely mechanical effect of adverse environmental conditions during uterine growth.

Although cyclopia is so well-known a type of monstrosity in fishes and other animals, almost all ichthyological examples recorded have been from members of the salmonidae of which embryos are so easily obtained from fish-hatcheries and the like. Besides the present case, only one other example of total or partial cyclopia has been recorded from the elasmobranchii—the historic Eagle Ray

[1] *The Teratology of Fishes* by J. F. Gemmill; Glasgow, 1912.

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(*Myliobatis noctula*—or *aquila*) described by F. Paolucci,[1] and now in the collection of the Technical Institute of Ancona; that specimen had not only been born, but had even survived until the day of its capture by fishermen. It is interesting to note that Myliobatidae, like Charcharidae, are viviparous.

It is possible that the malformation in the present case arose in some such manner as the following: after the embryo had developed normally for some time the outgrowing snout encountered obstruction at two points slightly above, and on either side of the median longitudinal axis, and the rostrum was compressed laterally and depressed downwards. As in the course of embryonic development the fore-part of the head was more and more strongly urged against the obstructions, the frontal extremity and sides became deflected downwards until they met in the mid-ventral line where continued constriction caused partial fusion of various organs.

According to Dr. Gemmill's theory, external pressure would have so upset the normal course of development that latent potentialities of cyclopia would have been given opportunity to assert themselves in formation of a specific and recognised teratological type.

There only remains the question as to whether the embryo could have survived, had it ever been born. In the vast majority of cases, any cyclopic tendency is accompanied by so great a malformation of the jaws, that the embryo is unable to feed; even did condition of the brain not preclude any possibility of survival. From the morphology of this specimen, however, there appears no sufficient reason for stating definitely that the young fish could not have survived. Paolucci's ray had the eye set in the anterior border of the head, which doubtless allowed it a wide range of vision, above, below and on either side. The position of the orbit in this shark would only have permitted of its seeing objects directly beneath it, or nearly so; while this should have been quite sufficient to have allowed it to have obtained its food, it is unlikely that with so limited a range of vision it could for long have escaped its natural enemies.

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[1] *Supra una Forma Monstuosa della 'Myliobatis Noctula'* by F. Paolucci; Atti. d. Soc. It. d. Sc. Nat. 17, fsc. 1; Milano, 1874.

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THE MEDICINAL AND POISONOUS PALMS OF INDIA.

BY

J. F. Caius, S.J., F.L.S.

The **Palmae** include about 200 genera with about 1,500 species, natives of tropical and subtropical regions, a few being found in the warmer temperate countries.

The medicinal and poisonous Palms of the world belong to 34 different genera:—Acanthophoenix (Mascarene Islands); Acrocomia (Tropical America; Brazil); Areca (Tropical Asia; Malay-Archipelago; New Guinea; Australia); Arenga (Tropical Asia; Malay-Archipelago; New Guinea; Australia); Astrocaryum (Tropical America); Attalea (Tropical America); Borassus (Tropical Africa; India, from Ceylon to the Sunda Islands); Calamus (Tropical and Sub-tropical Asia; Tropical West Africa; Australia); Caryota (Tropical Asia; Malay-Archipelago; Australia); Chamaerops (Mediterranean region); Cocos (Tropical and Sub-tropical America); Copernicia (America); Corypha (Tropical Asia; Malay-Archipelago); Diplothemium (Brazil); Elaeis (Tropical Africa and America); Euterpe (Tropical America; West Indies); Hyphaene (Africa; India); Licuala (Indo-Malayan region; New Guinea; North Australia); Lodoicea (Seychelles Islands); Loxococcus (Ceylon); Mauritia (Northern Brazil; Guiana; West Indies); Maximiliana (Tropical Brazil; Guiana; Trinidad); Metroxylon (Malay-Archipelago; New Guinea); Nannorhops (India; Afghanistan; Southern Persia); Neodypsis (Madagascar); Nipa (Tropical Asia; New Guinea; Australia); Oenocarpus (Tropical America); Orania (Malay-Archipelago; Papua); Phoenix (Sub-tropical Africa; Tropical Asia); Pinanga (Malay-Archipelago); Raphia (Tropical Africa; Madagascar; Tropical America); Serenoa (Florida, Southern California); Trachycarpus (Northern India; Burma; Northern China; Japan); Wallichia (East India).

The medicinal and poisonous Palms of India belong to 24 genera, either indigenous or introduced:—Acanthophoenix, Areca, Arenga, Attalea, Borassus, Calamus, Caryota, Chamaerops, Cocos, Copernicia, Corypha, Elaeis, Hyphaene, Licuala, Lodoicea, Loxococcus, Metroxylon, Nannorhops, Nipa, Phoenix, Pinanga, Raphia, Trachycarpus, Wallichia.

A. Leaves pinnatisect, leaflets free with reduplicate sides or confluent as a plaited limb. Flowers monoecious or dioecious:—

1. Male flowers minute, solitary or binate towards the tips of the branches, 3- or 6-androus; female larger, solitary ... ... , Areca

2. Male flower one on each side of a female, stamens 6 or more:—

a. Leaves unarmed ... ... Pinanga.

b. Leaves with long spines ... ... Acanthophoenix.

3. Male flowers 9-12-androus, female petals with valvate tips ... ... Loxococcus.

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4. Male calyx tubular. Stamens 6. Albumen equable — WALLICHIA.
5. Male sepals 3. Stamens many. Albumen equable — ARENGA.
6. Male sepals 3. Stamens many. Albumen ruminate — CARYOTA.
7. Male flower in catkin-like branches of a drooping androgynous spadix; female capitate at the apex of the spadix ... ... — NIPA.

B. Leaves pinnatisect; leaflets with implicate sides. Spadices interfoliar; spathe solitary. Flowers dioecious ... ... — PHOENIX.

C. Leaves flabelliform, orbicular or cuneiform. Spadices interfoliar; spathes many. Flowers usually bisexual:
1. Fruit with a smooth pericarp. 3 free carpels; each carpel with its own style or stigma:—
a. Seed curved-reniform; albumen with a single excavation near the raphe ... ... — TRACHYCARPUS.
b. Seed erect elliptic; albumen ruminate ... ... — CHAMAEROPS.
2. Fruit with a smooth pericarp. 3 appressed carpels, or carpels united where they meet; stigma one:
a. Spadix terminal; remains of stigma at the base of the fruit:
¶ Style short. Embryo apical ... ... — CORYPHA.
¶¶ Style subulate. Embryo dorsal ... ... — NANNORHOPS.
b. Spadix axillary lateral; remains of stigma apical:
¶ Berry drupaceous; endocarp hard brittle. Albumen equable ... ... — LICUALA.
¶¶ Berry with a soft membranous endocarp. Albumen deeply ruminate ... ... — COPERNICIA.

D. Leaves pinnatisect; leaflets with reduplicate sides. Spathes usually many. Fruit clothed with reflexed shining closely imbricating scales:—
1. Stem short, stout, annulated. Leaflets linear with the midrib and edges spinulose. No common spathe, but many small incomplete sheaths ... ... — RAPHIA.
2. Stem elongate. Leaflets acuminate, quite entire, nerves parallel. Spathes tubular, persistent:—
a. Polycarpic spadices axillary ... ... — CALAMUS.
b. Monocarpic spadix very large, terminal ... — METROXYLON.

E. Leaves flabelliform. Spadices interfoliar; spathes numerous, sheathing. Flowers dioecious; males minute, sunk in the cavities of the catkin-like branches:
1. Stamens 6. Fruit mostly with 3 stones; pericarp thinly fleshy, seeds sinuate ... ... — BORASSUS.
2. Stamens 6. Fruit by the abortion of the carpels, unilocular with one central, woody, ovate stone; pericarp fibrous with a shining epiderm ... ... — HYPHAENE.
3. Stamens 8. Fruit generally with 1 bilobed kidney-shaped stone. Seeds bilobed ... ... — LODOICEA.
4. Fruit large, ovate or oblong, with a dry fibrous outer covering, red or greenish-brown. Seeds usually 3, sometimes 4 or 5 ... ... — ATTALEA.
5. Fruit obovoid, terete or trigonous, 1-seeded ... — COCOS.
6. Fruit ovoid or obovoid, 1-3-seeded. Pericarp spongy and oily ... ... — ELAEIS.

ACANTHOPHOENIX.

This genus numbers only four species, natives of the Mascarene Islands where they grow abundantly. Two of them, *A. rubra* with a globose fruit and *A. nobilis* with an oblong-cylindric fruit, are cultivated in some of our Indian gardens.

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Acanthophoenix rubra Wendl. (=*Areca rubra* Bory) is a very elegant palm. Its root is a popular diuretic at La Reunion, and the light red decoction is a favourite cooling drink.

French: Palmiste rouge—; *German*: Rote Dornen-Areka.

Areca.

The genus comprises about 40 species. They are very ornamental and graceful palms inhabiting Tropical Asia, the Malay Archipelago, New Guinea, and Australia.

Only one species, *A. catechu*, is known to be medicinal. Its seed, the betel-nut, is a masticatory of great antiquity with most of the Asiatic races. It is used as an astringent, stimulant and anthelmintic in China, Indo-China, the Malay Archipelago, Australia, Melanesia, Polynesia, the West Indies, Madagascar, La Reunion, and Guiana. It was officinal in the pharmacopoeias of Germany, Sweden, and Switzerland.

Mention must, however, be made of two other species, *A. concinna* and *A. nagensis*, the fruits of which are used as substitutes for the betel-nut.

1. Stamens 6. Fruit 1½-2 in., smooth, orange or scarlet	*A. catechu.*
2. Stamens 6. Fruit 1½ in., umbonate, reddish-yellow .	*A. concinna.*
3. Stamens 3. Fruit 1 in., narrowed at both ends ...	*A. nagensis.*

1. **Areca catechu** Linn. The Betel Nut Palm is cultivated exclusively within the moist tropical tracts that fringe the coast of India, and practically within a belt of land that, with a few exceptions, does not extend inland for more than 200 miles. It rarely ascends to altitudes of 3,000 ft. and gradually disappears, even from the littoral area, as localities are entered where the duration of the dry hot months equals or exceeds the monsoons. It flourishes in the dry plateau of Mysore, Kanara and Malabar. It is usually seen as a garden plant, but occasionally and in certain localities, especially of Western and Southern India, of Ceylon and of Burma, it is grown in special gardens. In Eastern and Northern Bengal, in some portions of Assam and in Ceylon, its cultivation has assumed still greater dimensions.

In some parts of India a decoction of the ROOT is a reputed cure for sore lips.

The root is used in Cambodia for the treatment of liver complaints. It is mixed with numerous other drugs, and made into a decoction to be administered in jaundice.

Malay women use the young green SHOOTS as an abortifacient in early pregnancy.

The dry expanded PETIOLES serve as excellent ready-made splints for fractures.

In some parts of India the juice of the young tender LEAVES mixed with oil is applied as an embrocation in cases of lumbago.

In Cambodia the leaves are considered a good remedy for cough. Mixed with other drugs they are given in bronchitis after maceration in alcohol or vinegar. For lumbago they are reduced to pulp in a mortar and applied hot to the loins.

In Malabar an inebriating lozenge is prepared from the SAP of the tree.

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In Malaya the green FRUIT in its unripe state is sometimes used as a poison in combination with opium.

The fact that the use of fresh betel-nuts gives rise to a sensation of strangling and giddiness is well known in the East, and it has also been observed that the nuts of certain trees in most betel plantations retain their poisonous properties when dried. These trees cannot be distinguished from the others, so that not unfrequently accidents happen from their nuts becoming mixed with the produce of the plantation before their presence has been detected. The poisonous properties are destroyed by heat, and consequently many people use the cooked or red betel-nuts of commerce to avoid the possibility of accident. When such nuts have been eaten by mistake, salt or lime juice, or acid pickles are the best remedies.

Yunani practitioners consider the NUT digestive, astringent, diuretic and emmenagogue. They recommend it as a cardiac and nervine tonic; and they use it as an astringent lotion for the eyes.

Hindu medical writers describe the unripe nuts as laxative and carminative; the fresh nuts as intoxicating, productive of giddiness, and harmful to the eyesight; when dried, they are said to sweeten the breath, strengthen the gums, remove bad taste from the mouth, and produce a stimulant and exhilarant effect on the system. Their use is recommended in calculous affections and other urinary disorders, and as an aphrodisiac; for the latter purpose a confection is made by boiling the nuts in milk and adding a number of aromatic and stimulant substances.

The nut is commonly used as an astringent for bleeding gums; in the Punjab, women employ it both internally and locally for stopping discharges from the vagina. In Ceylon it is scraped and applied externally to ulcers.

The seed, reduced to charcoal and powdered, is said to be an excellent dentifrice.

The water in which unripe nuts have been boiled is often given to women along with powdered red betel and other spices after confinement as a gentle stimulant.

The nut is useful in checking the heartburn of pregnancy. Control experiments made with tincture of catechu have shown the superiority of the nut, and would seem to demonstrate that this is not merely due to astringent action; it is quite possible that its property as a nervine stimulant enhances its utility.

In Cambodia the unripe fruit is considered a good remedy for diarrhoea. Five green nuts are heated over a slow fire until they become burning hot inside; they are then cut into slices and, while still hot, made into about a half-pint of infusion to be taken in the course of the day. In cases of dysentery the nut is combined with opium; a pellet of opium about the size of a large grain of maize for every nut. Seven incisions are made obliquely on the surface of the nut and they are filled with opium. The nut is then warmed over a very slow fire and whenever the opium swells it is forced back into the cuts until the whole mass has sunk into the flesh of the fruit. The cooking operation over, the nut is cut into slices and thrown in a pint of water. The whole is then boiled

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down to one third, and this is to be taken in the course of the day.

Concerning the immature fruit Koman writes: 'On the suggestion of a patient who informed me that he was cured of his consumption by a preliminary administration of the fresh juice of tender arecanuts followed by a prolonged use of pellitory, this drug was given to eight patients. The dose suggested was five ounces of the juice to be gradually sipped in the morning in the course of an hour or two. None of the patients could stand this dose, as it produced violent vomiting and purging. The dose was consequently reduced to half an ounce. Even half an ounce had a nauseating effect and generally produced two or three evacuations. I cannot understand why this preliminary treatment by this special method of purgation is considered necessary. As stated above the juice of the tender nuts acts in small doses as a laxative.'

In Travancore the nuts are variously prepared for use. Those that are used by families of rank are collected while the fruit is tender; the husks or the outer pod is removed; the kernel, a round fleshy mass, is boiled in water; in the first boiling of the nut, when properly done, the water becomes red, thick and starch-like, and this is afterwards evaporated into a substance like catechu. The boiled nuts being now removed, sliced and dried, the catechu-like substance is rubbed to the same and dried again in the sun, when they become of a shining black, ready for use. Whole nuts, without being sliced, are also prepared in the same form for use among the higher classes, while ripe nuts as well as young nuts in a raw state are used by all classes of people generally; and ripe nuts preserved in water with the pod are also used.

In Mysore the nuts are taken as they come from the tree, and boiled for some hours in an iron vessel. They are then taken out, and the remaining water is inspissated by continual boiling. This process furnishes *Kossa*, or most astringent *terra japonica*, which is black, and mixed with paddy-husks and other impurities. After the nuts are dried they are put into a fresh quantity of water and boiled again, and this water being inspissated like the former, yields the best or dearest kind of catechu, called *coony*. It is yellowish brown, has an earthy fracture, and is free from the admixture of foreign bodies.

In the north of China, small pieces of the nut are boiled and the decoction is taken as a domestic remedy in various visceral affections.

The powdered nut, in doses of ten or fifteen grains every three or four hours, has been used with satisfactory results in the relaxed condition of the bowels which sometimes occurs in tropical climates. Large doses, six drachms to one ounce, however, produce griping and irritation; and loose motions may start as a result of such irritation.

In some parts of China the nuts, bruised and powdered, are mixed with the green food given to horses, and they are thus considered a preventive against diarrhoea.

In Europe betel-nuts have been used as an anthelmintic for

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tapeworm and as an astringent; and in veterinary practice their reputation as a vermifuge is well established.

In India and China the powdered nut is generally given for the expulsion of tapeworm in the dose of 4 to 6 drachms, taken in milk. It is said to be efficacious against round as well as tapeworms. Powell thought so highly of its anthelmintic properties that he expressed the opinion that the habit of chewing arecanut among the inhabitants of certain countries where intestinal parasites are common, is a protective habit instinctively acquired on account of its prophylactic value against these parasites. Waring, however, declared that the nut 'can hardly have any claim to this character, as amongst the Hindu and Burmese, who use it habitually as a masticatory, intestinal worms (lumbrici) are almost universally met with'.

Bentley (1904) and Schueffner (1912) treated a number of cases of hookworm disease with half to one ounce doses of the powdered nuts with little effect. Caius and Mhaskar (1924) gave four drachms of the recently-dried seeds in the form of a powder without any preliminary preparation and without any after purgative in cases of roundworm and hookworm infections. The patients passed one to three semi-solid stools, but no worms were expelled. The powdered fresh nut produced a stronger irritant effect on the intestine, but no worms were expelled. Chopra and Chandler (1928) believe that the chewing of betel-nut and betel-leaf does influence the number of hookworms harboured. This result is not, however, attributable to any anthelmintic power of the juice, which is not swallowed; but to the constant spitting which tends to eliminate the immature hookworms while making their way from the trachea to the oesophagus. The chewing of tobacco has a similar effect, and in some places is credited with anthelmintic power.

Sushruta recommends arecanut as an antidote to snake and scorpion venoms. By injecting cobra venom into dogs and scorpion venom into mice Mhaskar and Caius (1931, 1932) have shown experimentally that the nut has no preventive, antidotal, or therapeutic value.

The seeds were first examined by Bombelon (1886) and later by Jhans (1888-1891), who isolated, in addition to choline, the four alkaloids arecoline, arecaidine, arecaine, and guvacine, of which arecaine is now known to be identical with arecaidine. Emde (1915) added to these arecolidine, and K. Hess (1918) guvacoline.

Of these alkaloids arecoline alone exhibits markedly toxic properties. It belongs to the nicotine-pilocarpine group and acts on the central and peripheral nervous system producing paralysis, which may be preceded by convulsions. With nicotine the central and with pilocarpine the peripheral action is more marked, whilst both are about equal in arecoline. Arecoline hydrobromide is recognised in the pharmacopoeias of France, Germany, Hungary, Russia, Spain, Sweden, Switzerland and Turkey; it is used internally in small doses as a sialogogue and diaphoretic, and as an anthelmintic. It has also been employed like physostigmine to produce contraction of the pupil.

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Amboina: Buah, Puah—; *Andamans*: Ahbuddah, Ahpurruddah—; *Annam*: Cay cau, Cay cau gia—; *Arabic*: Fofal, Fufal—; *Assam*: Tambul—; *Banda*: Pua—; *Bengal*: Gua, Supari—; *Burma*: Kun, Kunsi, Kuntheebin, Kwamtheebeng—; *Cagayan*: Bua—; *Cambodia*: Dom sla, Sla—; *Canarese*: Adake, Adaki, Adike, Betta, Bettadike, Bette, Chikaniyadike, Chikke, Cotadike, Kaungu, Khhapura, Poga, Puga, Pugiphala, Tambula—; *Caniarines*: Banga—; *Cantonese*: Pan Long—; *Chinese*: Ping Lang—; *Deccan*: Supari, Supyari—; *Dutch*: Arecapalmboom, Pinang—; *English*: Areca Nut Palm, Areca Palm, Betel Nut Palm, Betel Nut Tree, Betel Palm, Cashoo Nut Tree, Catechu Palm, Catechu Tree, Drunken Date Tree, Fasel Nut, Fauselnut Tree, Medicinal Cabbage Tree, Indian Nut Tree, Pinang Palm, Supari Palm—; *French*: Arec, Arec bétel, Arec cachou, Arec de l'Inde, Arèque, Aréquier, Pinangue—; *French Guiana*: Arec—; *German*: Arecapalme, Arikapalme, Betelnusspalme, Betelpalme, Catechupalme, Katechupalme, Kaupalme, Pinangpalme—; *Guam*: Pugua—; *Gujerati*: Hopari, Phophal, Sopari—; *Hindi*: Supari, Suppari, Supyari—; *Ilocano*: Boa—; *Italian*: Areca—; *Java*: Bhunghanapenang, Jambe, Jebug—; *Konkani*: Fufal, Maddi, Supari—; *Laos*: Kok mak—; *La Reunion*: Arec, Pak—; *Malay*: Pinang—; *Malaya*: Chiniping—; *Malayalam*: Atekka, Chempalukka, Chhonta, Kalunnu, Kamuka, Kavunnu, Kazhangu, Khhapuram, Kramukam, Pakka, Pugam—; *Marathi*: Pophali, Pung, Supari—; *Mundari*: Kasailidaru—; *New Britain*: Bue—; *Pampangan*: Luyos—; *Pelew Islands*: Bua—; *Persian*: Girdchob, Popal, Pupal—; *Philippines*: Bongapalo, Bongasantol, Lugos, Mangupod—; *Porebunder*: Hopari—; *Portuguese*: Areca, Arequeira—; *Russian*: Areka, Kapustnaya palma—; *Sanskrit*: Akota, Chhataphala, Chikkana, Dirghapadapa, Dridhavalkala, Ghonta, Gopadala, Guvaka, Kapitana, Karamatta, Khapura, Kramuka, Puga, Pugi, Rajatala, Suranjana, Tambula, Tantusara, Valkataru—; *Santali*: Gua—; *Sinhalese*: Puvakka, Puwak—; *Solomon Islands*: Boa—; *Spanish*: Arequiero—; *Swedish*: Areka—; *Tagalog*: Bonga, Bongangmatulis, Bunga, Mangipod, Sacsic—; *Tamil*: Kamugu, Kandi, Kiramugam, Kugagam, Pakku, Pakkuppanai, Pugam, Tuvarkkay—; *Telugu*: Chikinamu, Chikini, Gautupoka, Khapuramu, Kolapoka, Kramukamu, Oppulu, Oppuvakkulu, Poka, Prakka, Pugamu, Vakka—; *Tulu*: Kangu—; *Urdu*: Supari—; *Uriya*: Gua, Pugo, Supari, Trinodrumo—; *Visayan*: Bonga—.

2. **Areca concinna** Thw. is endemic in Ceylon and is to be found in the forests of the moist low country; Subarayamuwa, Reigam Korale, Pasdun Korale. It is known as *Len-teri*. It is occasionally planted; the fruits, however, which are also chewed with betel, like those of *A. catechu*, are generally obtained from wild trees.

3. **Areca nagensis** Griff. is found in the Naga Hills, up to 800 ft., very scarce, usually on high situations on river sides. The Nagas and Abors use its fruit as a substitute for the betel-nut.

Naga: Talpat—; *Singpho*: Tongtau—.

Arenga.

This genus comprises about 10 species of tall, stout palms, distributed throughout Tropical Asia, the Malay Archipelago, New Guinea, and Australia.

A. Engleri Becc. and *A. saccharifera* Labill. are used medicinally by the Chinese.

A. obtusifolia Mart. and *A. saccharifera* Labill. are used as poisons by the Malays. They are both cultivated in India.

1. Leaflets bifarious ... ... *A. obtusifolia.*
2. Leaflets 4-5-fariously fascicled ... ... *A. saccharifera.*

1. **Arenga obtusifolia** Mart. (=*A. Westerhoutii* Griff.) is a native of the Malay Peninsula—Naning, Penang—cultivated in India.

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The ripe fruit is an irritant to the mucous membranes. It causes an acute swelling of the mouth and fauces when taken internally, and this is probably due to the mechanical irritation of needle crystals. The juice obtained from it is used by the Malays to poison their enemies. The pulpy part of the fruit is boiled and crushed; and the juice, after straining, is administered in coffee. It is said to cause dyspnoea and restlessness. In the Philippine Islands it is used by the Tagals for poisoning fish.

Malacca: Anooee Kutaree—; *Penang*: Langkab, Langcap—.

2. **Arenga saccharifera** Labill. Sago Palm (=*Saguerus rumphii* Roxb.=*Borassus gomutus* Lour.) is a beautiful and magnificent palm found in Assam, Martaban and Tenasserim, occasionally on the Pegu Yoma; commonly cultivated in India. It is distributed throughout the Malay Peninsula and Archipelago, and ascends in Java up to 4,000 ft.

In Cambodia the root is considered stomachic and pectoral. It is said to be very serviceable in bronchitis marked with profuse expectoration.

The petioles are credited in Cambodia with diuretic and antithermic properties. They are prescribed in chronic paludism with enlargement of the spleen.

The juice of the fleshy outer covering of the fruit is highly stimulating and corrosive. If applied to the skin it causes great pain and inflammation. It is said that the inhabitants of the Moluccas were in the habit of using in the defence of posts during the war a liquor obtained by the maceration of this fruit, which the Dutch appropriately called 'hell-water'. It is used by the Malays to poison their enemies. The pulpy part of the fruit is boiled and crushed, and the juice, after straining, is given in coffee.

Burma: Taungong, Toungong—; *Cambodia*: Thnotnhi—; *Chinese*: So Mu Mien—; *Dutch*: Aren, Arenboom, Sreng, Arengboom, Arengpalm, Arenpalm, Gamoetoeboom, Gomoetipalm, Gomoetoepalm, Sagoeweerpalm, Sagueerboom, Sagueerpalm, Saguweerpalm, Suikerboom—; *English*: Areng Palm, Gomuti Palm, Malay Sago Palm, Sago Palm, Sugar Palm—; *French*: Anou, Arbre au sagou, Aren à sucre, Areng, Gomonto, Gomuti, Lantar, Lontar, Palmier areng, Palmier rondier, Palmier à sucre, Rondier—; *German*: Echte Zuckerpalme, Gomutipalme, Sagwirepalme, Zuckerpalme—; *Ilocano*: Ratipan—; *Java*: Aren, Buwah atap, Duk, Kolang Kaling, Lirang—; *Madura Island*: Dhuk, Edhuk—; *Malacca*: Gumuti—; *Malay*: Anan, Berkat, Kabong—; *Pangasinan*: Anibung—; *Philippines*: Baru—; *Sunda Islands*: Kawung—; *Tagalog*: Cauon, Iroc, Pugahan—; *Tamil*: Kichilippanai, Kumudippanai, Segovarisi—; *Visayan*: Bahi, Hibioc, Hidioc, Ibioc, Idioc—.

Attalea.

The genus is Tropical American. It consists of about 23 species distributed in various parts of South America, especially in the vicinity of the Amazon and its tributaries, from the level of the sea to a height of 4,000 ft. above it.

Attalea speciosa Mart. is the *Uanassu* Palm of Brazil and Guiana, cultivated in India. The oil from the fruit is much used in Guiana in the treatment of rheumatic pains.

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Borassus.

Martelli (1913) has proved conclusively that there are at least 7 species belonging to this genus. They inhabit Tropical Africa, India, from Ceylon to the Sunda Islands, and Northern Australia.

B. flabellifer var. *aethiopum* Warb. is used medicinally in the Gold Coast.

Borassus flabellifer Linn. The Palmyra Palm is a native of India. It extends in North-West India as far north as Aligarh and Shahjehanpur. Isolated trees in gardens are found in Rohilkhand and the Upper Ganges Doab, as far as Saharanpur. Also on both sides of the Persian Gulf, attaining there about the same latitude as in North-West India. Immense groves of it are found on the Malabar Coast, extending from Cape Comorin through Travancore, Calicut, Goa, and the Bombay Presidency, on through Gujerat and, some distance up, on the banks of the Indus. But what are emphatically called the Palmyra regions may be included in a line extending along the Coromandel coast from Cape Comorin to Madras, including the northern portion of Ceylon, and from Madras all along, taking in a considerable belt of the coast between that and Point Palmyras, and then passing up to Gaya. After that the line should be carried on about due east until it reaches Ava, below which, on the banks of the Irrawaddy, there are immense groves of this palm.

The Palmyra Palm is found in various parts of the mountain district of Ceylon, including the vicinity of Kandy and Badulla at elevations of 1,680 and 2,450 ft., respectively, having a mean annual temperature of 74° at the former and 72° at the latter.

Although immense groves are found on the banks of the Irrawaddy, from the sea coast up to nearly as far as Ava or Amarapura in Burma, and as far inland as Gaya in Bengal, and in isolated patches all round and through Ceylon, still the most congenial places for the favourable development of the Palmyra Palm will be found in low sandy plains scarcely elevated above the level of the sea, and where they are exposed to the burning sun, and the force of at least one of the monsoons. Such are Jaffna, with the surrounding islands, and other portions of the Northern Province of Ceylon, the District of Tinnevelly, with portions of the Madura Collectorate, and portions of the Madras and Bombay Presidencies.

The therapeutic properties of the various parts of the Palmyra are described in detail in Sanskrit and Persian medical works. They may easily be gathered from the following records of popular therapy.

The ROOT is considered cooling and restorative. The expressed juice of the young root is used in cases of gastric catarrh and to check hiccup.

In Cambodia the root is said to be a good diuretic and anthelmintic; it is much employed as a cure for gonorrhoea. In Guinea the young roots are boiled in water and the decoction is given in diseases of the respiratory tract.

The decoction of the BARK, with a little salt added to it, is a good astringent gargle for strengthening the gums and the teeth.

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Reduced to charcoal and pulverised, the bark makes a good dentifrice.

In some parts of Southern India an extract of the green LEAVES is used internally in secondary syphilis.

The light-brown cotton-like substance from the outside of the base of the leaves is employed in Ceylon as a styptic for arresting haemorrhage from superficial wounds.

The ash of the SPATHE is an antacid in heartburn. It acts as a powerful blister, and is applied on enlarged liver and spleen in combination with some other demulcents.

In Cambodia the SPADIX is considered anthelmintic, diuretic, and antithermic. It is useful in abdominal troubles complicated with swelling and fever, more especially in chronic malarial poisoning with enlargement of the spleen.

The ash of the spadix is given internally in bilious affections, and is largely used as an antiperiodic in many parts of India.

The fresh juice of the plant or TODDY is cooling, sweet and useful in inflammatory dropsy, and gastric catarrh. It acts as a laxative when taken regularly for several mornings. It is helpful in checking hiccup. It is a good diuretic in gonorrhoea, and a good tonic in emaciation or phthisis. It is used as an adjunct to stimulating drugs in the low stages of intermittent and remittent fevers.

The juice is used as a stimulant and antiphlegmatic. A useful stimulant application, called toddy-poultice, is prepared by adding fresh-drawn toddy to rice-flour till it has the consistence of a soft poultice, and this being subjected to a gentle fire, fermentation takes place. This, spread on a cloth and applied to the parts affected, acts as a valuable application to gangrenous ulcerations, carbuncles, and indolent ulcers.

The fermented juice is intoxicating. Slightly fermented it is prescribed in diabetes. The Ayurvedists of Southern India prescribe it also in consumptive cases.

The pulp of the ripe FRUIT is applied externally in skin diseases. The kernel is bruised and applied to the sting of scorpions; but, Caius and Mhaskar have shown experimentally that this has no preventive, antidotal or therapeutic value.

The gelatinous contents of the unripe SEEDS is considered cooling and restorative. It is used as a remedy for nausea and vomiting.

The embryo of the germinating seed is said to be cooling, nutritive and diuretic.

In Cambodia the YOUNG PLANT is given in gonorrhoea and is, moreover, considered antibilious and antidysenteric.

The TERMINAL BUD of the tree is credited with the same therapeutic properties as the embryo of the germinating seed, and is considered cooling, nutritive, and diuretic.

Palm SUGAR is antibilious and alterative; it is used in hepatic disorders and gleet. Candy is given in coughs and pulmonary affections.

The sugar from the Palmyra Palm is considered a valuable antidote in Cambodia. The Khmers say it is a specific for *Strychnos* poisoning.

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Bengal: Tal, Talgachh—; *Burma*: Tan—; *Cambodia*: Thnot chhmoul—; *Canarese*: Karitale, Ole, Oleya, Pane, Tala, Tale, Tali, Trinaraja—; *Ceylon*: Pannamaram—; *Deccan*: Taarkdizaar—; *Dutch*: Jagerboom, Weingeevende palmboom—; *English*: Brab Tree, Char Palm, Desert Palm, Fan Palm, Palmyra Palm—; *French*: Cocotier de mer, Rondier, Rondier éventail—; *Fulah*: Doubé—; *German*: Palmyrapalme—; *Gujerati*: Tad—; *Hindi*: Tal, Tar, Tarkajhar—; *Konkani*: Tadmadd—; *Malayalam*: Ampana, Eta, Karimpana, Pana, Talam, Trinarajan—; *Malinke*: Cébé—; *Marathi*: Tad, Tamar—; *Porebunder*: Mototad—; *Portuguese*: Palmeira macha brava—; *Sanskrit*: Asavadru, Bhumipishacha, Chirayu, Dhvajadruma, Dirghadru, Dirghapadapa, Dirghaskanda, Dirghataru, Drumashreshtha, Drumeshvara, Guchhapatra, Karapatravan, Lekhyapatra, Madadhya, Madhurasa, Mahonnata, Patri, Shataparva, Tala, Taladruma, Tamsi, Tantugarbha, Tantuniryasa, Taruraja—; *Sinhalese*: Tal, Talgaha—; *Soussou*: Kanké—; *Tamil*: Anbanai, Edagam, Karadalam, Karambanai, Nilam, Nungu, Panai, Pondai, Pondu, Pul, Purbadi, Puttrani, Sattruppanai, Talai, Talam, Tali—; *Telugu*: Karatalamu, Namatadu, Pentitadu, Potutadu, Tadu, Trinarajamu—; *Tulu*: Ole, Tari—; *Urdu*: Tad—; *Uriya*: Talo, Tanlo, Trinorajo—.

Calamus.

This genus numbers over 200 species inhabiting tropical and sub-tropical Asia, Malaya, the Philippine Islands, New Guinea, and Australia; a few are met with in tropical Africa.

C. margaritae Hce. is used medicinally in China; *C. rotang* Linn. and *C. verus* Lour. in Annam and Cambodia.

C. verus also enters into the composition of poisons prepared by the Malays for arrows and blowpipe darts.

The resin from *C. draco* Willd. is officinal in Portugal.

Three out of the 52 Indian species are credited with medicinal properties.

1. Leaflets many, equidistant, linear uniform ...	*C. rotang.*
2. Leaflets in distant opposite groups of 3-5	*C. travancoricus.*
3. Leaflets in very distant groups of 3	*C. rheedei.*

1. **Calamus rotang** Linn. The Rattan is distributed over the Central Provinces, the Deccan, the Carnatic, and Ceylon; not in Bengal.

The ROOT in combination with other drugs is prescribed for snake-bite in Bhavaprakasha, Rasaratnakara, Yogaratnakara, and Sharangdhar-samhita. It is also prescribed for scorpion-sting in Rasaratnakara, and Vaidyavinoda. Mhaskar and Caius have, however, proved conclusively that the drug either single or in combination does not in any way counteract the poisoning effects of either snake or scorpion venom.

The root is much used medicinally in Cambodia where it is credited with antidysenteric, antibilious, hypotensive, tonic, febrifuge, and depurative properties. In veterinary practice it is employed as a tonic and aperient.

The WOOD is given as a vermifuge in Annam.

Annam: Cay may—; *Bengal*: Bet, Beta, Chachibet—; *Bombay*: Bet—; *Cambodia*: Lompeak, Rompeak—; *Canarese*: Betta, Habbe, Nagabetta—; *Central Provinces*: Prabba, Pepa—; *Dutch*: Rotting, Rottinggewas, Rottingriet runt, Runtstek, Spaansch riet—; *English*: Cane, Chair-bottom Cane, Common Rattan, Rattan, Rotang, Slender Rattan, Water Rattan—; *French*: Canne de Bengale, Canne épineuse, Canne à main, Jonc de l' Inde, Ratin, Rotang, Rotin, Rottain—; *German*: Palmriet, Rattangpalme, Rotang, Rottang, Rotting, Spanisches Rohr, Steinrottang, Stuhlrohr—; *Gujerati*: Natar—; *Hindi*: Bet, Beta, Chachibet—; *Malay*: Rottamm, Rotan—; *Malayalam*: Chural, Nirvanni, Purampu—;

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Marathi: Beta, Veta—; *Persian*: Bed—; *Sanskrit*: Abhrapushpa, Dirghapatraka, Dirghavalli, Gandhapushpa, Kalana, Latavamsa, Manjari namra, Nichula, Ratha, Rathabhra, Shita, Sushena, Vanira, Vanjula, Vetasa, Vetasi, Vetra, Vidula—; *Sinhalese*: Wewel—; *Spanish*: Caña de Bengala, Caña de Indias—; *Tamil*: Arini, Mellisuppirambu, Nirvanji, Pirambu, Pisin, Sadi, Sural, Suvedagandam, Suvedam, Vaniram, Vanjikkodi, Vedasam, Vettiram—; *Telugu*: Suvedagandam, Suvedam, Vaniram, Vanjikkodi, Vedasam, Vettiram—; *Tulu*: Bethama, Bettamu, Niruprabba, Pemu, Prabba, Prabili, Sannabettamu—; *Tulu*: Suralbetta—.

2. **Calamus travancoricus** Bedd. is found in the Deccan peninsula: from Malabar to Travancore. The tender leaves are used in dyspepsia, biliousness, and ear troubles; they are considered anthelmintic.

Canarese: Nayibetta—; *Malayalam*: Cheruchural, Kattuchural—.

3. **Calamus rheedei** Griff. grows in Malabar where its powdered dried seed is applied to ulcers.

Malayalam: Kattuchural—.

Caryota.

The 12 species which compose this genus are distributed throughout Tropical Asia, Malaya and Australia.

Of the three indigenous species two are used medicinally.

1. Leaves 18-20 ft. long ... ... *C. urens.*
2. Leaves 4-9 ft. long ... ... *C. mitis.*

1. **Caryota urens** Linn. The Fish-tail Palm is found all over India in the forests of the western and eastern moist zones. It is common in Burma, Bengal and Orissa, ascending in Sikkim to 5,000 ft. On the Western Ghats, it extends to near Mahableshwar. It is reported to abound in the south-eastern corner of Aheree in the Chanda District.

According to Ayurvedists the NUT is acrid and cooling; it allays thirst and fatigue.

The nut is used as an application to the head in cases of hemicrania.

A glass of the freshly drawn TODDY, taken early in the morning, acts as a laxative; it is thus much used by the people of Malabar.

Assam: Baraflawar—; *Bombay*: Birlimhad, Birlimhar—; *Burma*: Kimbo, Minbaw, Minbo—; *Canarese*: Bagani, Baini, Bayne—; *Deccan*: Marikajhar—; *Dutch*: Jagerieboom, Nieboom, Sagueerboom, Wilde Sagueerboom—; *English*: Bastard Sago Palm, East Indian Wine Palm, Elephant's Palm, Fish-tail Palm, Ghaut Palm, Hill Palm, Indian Sago Palm, Jaggery Palm, Kittul Tree, Malabar Sago Palm, Mhar Palm, Toddy Palm, Wine Palm—; *French*: Caryote brûlant, Faux sagonier de l' Inde, Palmier céleri—; *German*: Bastardsagopalme, Ostindische Brennpalme, Sagopalme—; *Gujerati*: Shankrajata, Shivajata—; *Hindi*: Mari, Marikajhad—; *Khond*: Sarta—; *Konkani*: Birlamadd, Birlimad—; *Lepcha*: Runbong, Simong—; *Magahi*: Hlyamban—; *Malayalam*: Anappana, Chundapana, Chuntappana, Irampana, Kalapana, Vainavu—; *Marathi*: Ardhimpari, Ardhisupari, Berli, Berlimad, Berlimada, Berlimhar, Bherawa, Bherlamuda, Bherlimad, Bhirlimahad, Birli, Mad—; *Philippines*: Cabonegro, Sagu, Taguipan; *Pörebunder*: Mervajata—; *Portuguese*: Palmeira brava—; *Sanskrit*: Dhoajavriksha, Dirgha, Mada, Madadruma, Madyadru, Madyadruma, Mohakari, Rajju, Vitanaka—; *Saora*: Jivalaggu—; *Sinhalese*: Kittul, Nepora—; *Tagalog*: Pugaban, Taquipan—; *Tamil*: Adam, Irambanai, Kondapauni, Kundarbanai, Pugam, Talam, Thippali, Tippilippanai, Udalarbanai—; *Telugu*: Bakini, Jivalaggu, Kondajivalaggu, Jiluga, Mare, Yatrakatari—; *Tulu*: Indu, Kannida—; *Uriya*: Modhura, Salapo, Solopo—.

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2. **Caryota mitis** Lour. This very elegant palm is found in Burma—from Arakan southwards, Martaban, the Malay Peninsula, Penang, the Andaman Islands, and the Malay Archipelago.

In Malaya the FRUIT is put into wells with intent to cause annoyance. Bathing with well-water that has been treated in this way gives rise to an intense itching of the skin, and may cause an acute inflammation of the eyes. The fresh juice of the fruit when applied directly to the skin is extremely irritating.

The juice of the fruit, mixed with bamboo hairs and an extract of toad, is considered a very potent poison in Kelantan.

In Cambodia the soft fibres at the base of the LEAF-SHEATH are used in the cauterisation of wounds.

Cambodia: Anse—; *Malay*: Beredin, Meredin, Tukkus—; *Penang*: Dudur—.

CHAMAEROPS.

The two species of this genus inhabit the western part of the Mediterranean region.

Chamaerops humilis Linn., Dwarf Fan Palm, is the only palm indigenous to Europe. It is found as far up as Nizza in Italy; but thence southwards it has a great range, being met with in all the countries bordering the Mediterranean Sea. It is very common in Algeria.

The fruit is astringent.

Andalusia: Palma—; *Arabic*: Doum—; *Catalan*: Margallo, Margallonera—; *English*: Dwarf Fan-Palm, European Palm—; *French*: Palmier nain, Palmiste—; *Italian*: Cefaglioni, Palma nana, Palmito—; *Maltese*: Ginmmar—; *Portuguese*: Palma das Vassouras, Palmeira—; *Sicily*: Curina, Ginmmara, Palmetta, Piumara—; *Spanish*: Palma enana, Palmito—.

Cocos.

The genus consists of about 30 species, all American, one of them cosmopolitan in the tropics.

C. coronata Mart., *C. flexuosa* Mart., *C. nucifera* Linn., *C. schizophylla* Mart., *C. yatai* Mart. are used medicinally in Brazil; *C. nucifera* Linn. is similarly used in India, Indo-China and China.

The fat from the kernel of *C. nucifera* Linn. is officinal in Holland and in Portugal.

Three of the therapeutically active species are to be met with in India.

1. Leaves 1.8-4.5 m. long ... ... *C. nucifera.*
2. Leaves 1.8-2.4 m. long ... ... *C. schizophylla.*
3. Leaves surrect, arcuate; leaflets concinnous ... *C. yati.*

1. **Cocos nucifera** Linn. The Coconut Palm is found at present in every part of the tropics, where it flourishes in the greatest luxuriance in the vicinity of the sea, especially a few feet above high-water mark. Although that is its chief habitat, it cannot be termed an exclusively littoral plant, for it has been met with far inland—at Merida in Yucatan, at Patna in Bihar, at Concepcion del Pao—. Whenever the Coconut Palm ventures beyond the limits of the tropics, it loses in elegance of aspect and power of productiveness. In the Sandwich Islands, just at the edge of the torrid

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zone, it has a mean look, and yields fruit in comparatively small quantities.

The young ROOT is employed as an astringent gargle in sore throat. Boiled with ginger and salt it is efficacious in fevers.

The Ayurvedists credit it with anthelmintic value; but it is rarely, if ever, used as a worm remedy in India. It is popularly known as a diuretic and commonly used as such. It is also prescribed in uterine diseases and in dysentery.

In Cambodia an infusion of the root is considered as a valuable diuretic which is administered in gleet, bronchitis, and liver troubles with or without jaundice.

In Ceylon the root is said to strengthen the gums, and in Tahiti it is occasionally used instead of arecanut by betel-chewers.

In the Gold Coast the BARK is used for curing toothache and earache. Yunani practitioners in India recommend the ash of the bark as a dentifrice and an antiseptic; they prescribe it in scabies.

The TOMENTUM—a soft, downy, light-brown coloured substance found on the outside of the lower part of the leaves, where they spring from the stem—is used for stopping blood in cases of wounds, bruises, leech-bites, etc. It is said to be a good styptic.

The FLOWERS, when used medicinally, are given as an astringent. Sanskrit authors recommended them as useful in the treatment of diabetes, dysentery, leprosy, and urinary discharges, though liable to induce constipation.

If TODDY is drawn early in the morning and drunk at once, it forms a pleasant drink having a slightly stimulating effect and acting as a gentle laxative.

Toddy is refrigerant and diuretic. Its immoderate use causes great harm, resulting in sleepiness, loss of appetite, premature old age, extraordinary obesity, and diseases resembling dropsy and scurvy. Some of those who are addicted to it lose their intellectual faculties, are seized with trembling, or become stupid, absent-minded, or even insane.

Toddy is considered by Europeans as highly unwholesome during the rainy season.

A toddy-poultice is prepared by adding fresh-drawn toddy to rice-flour till the consistence of a soft poultice, subjecting to a gentle fire, and spreading on a cloth. It forms a valuable application to gangrenous ulcerations, indolent ulcers and carbuncles.

The outside scrapings of the HUSK and LEAVES applied to ulcers will cleanse and heal them rapidly if soaked in proof rum.

The husk of the fruit is used in the treatment of tapeworm.

The green FRUIT is given as a refrigerant, and especially employed as an astrigent in the sore-throats of children.

The MILK of the green fruit is a cooling drink, antiemetic and soothing, and useful in allaying urinary irritation. It is a good drink for cholera cases, and it is said to check vomiting when other means fail. If drunk in immoderate quantity the milk of young nuts may produce a slight degree of strangury and a predisposition to dropsical complaints. It is commonly admitted in Bengal that too much cocoanut milk induces a hydrocele swelling

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of the scrotum. Among the Tahitians the milk is considered as one of the exciting causes of elephantiasis.

In Brazil the milk of immature nuts is applied as a lotion to ulcers of the penis.

The expressed juice of the fresh kernel has been successfully employed in general ill-health, malnutrition, debility, incipient phthisis, thirst, fever and urinary disorders. In large doses it proves aperient, and in some cases actively purgative, on which account it has been suggested as a substitute for castor-oil.

The water of the ripe nut is unwholesome and can be drunk only sparingly, as it is strongly diuretic and is apt to produce an irritation of the bladder and urethra.

In French India the milk is given internally as an antidote for snake venom; but Mhaskar and Caius have proved satisfactorily that it has no such action. Bapat had already noted that two parts of cocoanut milk and 20 parts of sprouts of *Albizzia lebbek* given internally for three consecutive days cure all snake-bites 'with the exception of those of the cobra and the Russell's viper'.

Fresh cocoanut water is the antidote used by Malays to counteract *Sarcolobus* poison.

The fresh kernel or the tender pulp is nourishing, cooling and diuretic. In Ceylon it is given in sunstroke. The ash obtained from its calcination is said to be a valuable antacid and digestive.

The milk and meat of one nut eaten early in the morning, fasting, will expel the tapeworm if present. Caius and Mhaskar found this treatment ineffective in the case of hookworms.

The fresh OIL obtained by boiling the milk of the ripe fruit is used as an application for burns and in baldness. It is thought to have special properties in strengthening the hair, hence it is much in use as a local application in alopecia, and in loss of hair after fevers and debilitating diseases.

In the Konkan the oil which separates from the freshly-rasped kernel, alone or mixed with tamarind-seed oil, is used as an application to burns and rheumatic swellings.

An inunction of the oil to the whole body is used in fevers, and to the chest in lung diseases. In Ceylon the oil is applied to the head for cooling.

The oil is given in plethora and as a vermifuge in Jamaica. An emulsion of the oil and kernel is prescribed in coughs and pulmonary diseases generally.

In the Maldives cocoanut oil is esteemed a powerful antidote against the bite of poisonous reptiles.

The purified and prepared oil is used as a substitute for cod-liver oil in debility and phthisis. Its prolonged use, however, is apt to disturb the digestive organs and induce diarrhoea.

In Germany it is used in pharmacy, to a considerable extent, as a substitute for lard.

The TAR, obtained by covering the thoroughly ignited shell with a stone cup, is a rubefacient and an effectual domestic remedy for ringworm, itch and other parasitic affections.

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The old and dried KERNEL is cut into thin slices and used as an aphrodisiac ingredient in confection; also as an anthelmintic, it is given to remove tapeworms.

The terminal bud or CABBAGE is nourishing and digestive. Its fresh juice is cooling and diuretic.

In Cambodia the WOOD enters into the composition of a fumigant prescribed in the treatment of piles.

Ahanta: Kukui—; *Annam*: Cay dua—; *Aowin*: Agye—; *Arabic*: Jadhirdah, Jouzehindi, Narjil, Shajratuljouzehindi, Shajratunnarjil—; *Banziri*: Diko—; *Bengal*: Dab, Narakel, Narikel, Nairyal—; *Betsimisaraka*: Voaniho—; *Bicol*: Niog—; *Bombay*: Maar, Mahad, Mar, Naralchajhada, Narel, Naril, Naural—; *Brazil*: Coco da Bahia, Coqueiro da India, Inajaguasuiba—; *Burma*: On, Ondi, Ong, Onsi, Onti, Ung, Ungbin—; *Cagayan*: Niog—; *Cambodia*: Daung—; *Canarese*: Gitaka, Gitaku, Kobari, Kobbari, Kurube, Matte, Narikela, Narikera, Siyala, Tare, Tenginakayi, Tengu, Trinaraja—; *Chinese*: Yeh Tzu—; *Deccan*: Narel, Narelkajhar—; *Dutch*: Calappusboom, Cocos, Cocosboom, Cocospalm, Kalappus, Klapper, Klapperboom, Klapperpalm, Koko, Kokosboom, Kokosnootenboom, Kokosnootpalm, Kokospalm—; *English*: Cocoa Nut, Cocoanut Palm, Cocoanut Palm, Cocoanut Tree—; *Ewe*: Yevunai—; *Fanti*: Kube—; *French*: Cocotier, Roi des végétaux, Cocotier commun, Cocotier des Indes, Cocotier nucifère, Cocotier ordinaire, Cocotier porte-noix, Palmier—; *Ga*: Akokoshicho—; *Gabon*: Omangata—; *German*: Calappabaum, Calappusbaum, Cocosnussbaum, Cocospalme, Echte Kokospalme, Indianischer Nussbaum, Kokosbaum, Kokosgalen, Kokospalme, Kokospalmenbaum, Wandernde Seeuferpalme—; *Guam*: Niyog—; *Gujerati*: Naliyer, Nariel, Nariera, Nariyela, Naryal—; *Hausa*: Kwakwar Attagara—; *Hindi*: Narel, Nariel, Nariyal, Nariyalkaper, Nariyel—; *Ilocano*: Niog—; *Italian*: Cocco—; *Java*: Bhungkana, Bhungkananjijor, Enjor, Ijor, Kalapa, Kerambil, Klapa, Klendah, Njejor, Njijor, Njor, Tangkalkalapa, Wiiklapa, Witkrambil—; *Konkani*: Madd—; *Krepi*: Agorne, Naiti, Yevone, Yevune—; *Krobo*: Kokosi, Ngmaicho—; *Malayalam*: Chentennu, Chocham, Karikku, Kulittai, Langalam, Nalikeram, Narikelam, Tenna, Tennu—; *Marathi*: Mad, Mada, Mahad, Mar, Naral, Naralchajhada, Naralmad, Narel, Narela, Narula, Tenginmar, Varala—; *Mundari*: Burkadaru, Narieldaru—; *Mysore*: Nur—; *New Caledonia*: Nou, Nou boibate, Nou bouangae, Nou do, Nou goine, Nou jomalate, Nou kigoute, Nou mia, Nou pougne, Nou tamen, Nou tignii—; *Nzima*: Kukwe—; *Pahuin*: M'ban n'tang—; *Pampangan*: Ngongot—; *Persian*: Badinj, Darakhtebandinj, Darakhtenargil, Nargil—; *Philippines*: Coco, Lubi, Pangosin, Tapiasin—; *Polynesia*: Niu—; *Portuguese*: Coqueiro, Palmeira—; *Quittah*: Ene—; *Roumanian*: Cocotier—; *Russian*: Kokosovoe dyerevo—; *Sanskrit*: Dakshinatriya, Dridhanira, Dridhaphala, Durariha, Garikera, Jataphala, Junga, Karakambha, Kaushikaphale, Kurchashekhara, Kurchashirashaka, Langali, Mahaphala, Mangalya, Mriduphala, Mutkuna, Nadikeli, Narikari, Narikela, Nilataru, Payodhara, Phalakeshara, Phalamunda, Putodaka, Rasaphala, Sadaphala, Sadapushpa, Shiraphala, Skandhapal, Skandhataru, Subhanga, Sutanga, Toyagarbha, Trinaraja, Tryakshaphala, Tryambakaphala, Uchhataru, Varaphala, Vishvamitrapriya—; *Sinhalese*: Pol, Polgaha, Polgass, Polnawasi, Tambili—; *Spanish*: Cocotero, Rey de los vegetales—; *Tagalog*: Adiavan, Niog, Pamocol—; *Tamil*: Edagam, Ilangali, Keli, Muppudaikay, Nadigelam, Naligelam, Naligeram, Narigelam, Papparettennai, Talai, Ten, Tengay, Tengu, Tennai—; *Telugu*: Ettabondalakobbari Gujjunarikadamu, Kobbari, Kobbera, Nalikeramu, Narikadamu, Narikelamu, Narikeramu, Langali, Mukkantipandu, Te, Temranu, Tenkaya, Trinarajamu—; *Tulu*: Tare—; *Twi*: Kokosi—; *Urdu*: Nariyel—; *Uriya*: Gotoma, Langoli, Nodia, Paido, Poiu, Trinodrumo—; *Visayan*: Anibong, Bonotan, Botong, Cayomanis, Dahili, Lobi, Lubacan, Niogngapoti, Lobingahinbaon, Lobingapilipog, Limbaon, Niog, Pangonn, Pilipog, Potot, Tamis, Tamisan, Tayomanis—; *Zambales*: Ongot—.

2. **Cocos schizophylla** Mart., Aracuri Palm, is a native of Brazil found in the Province of Bahia at Camamu and Bahia, San Jorge dos Lheos. It is cultivated in Indian gardens.

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In the Province of Bahia the juice of the unripe fruit is used for inflammation of the eyes.

Brazil: Alicuri, Aracui, Aricuri, Ariri—; *English*: Aracuri Palm—.

3. **Cocos yatai** Mart. inhabits Argentine—provinces of Concordia, Corrientes and Entre Rios—and Brazil. It is cultivated in Indian gardens.

In Argentine, where it is known as *yatai*, the fleshy parts of the fruit are considered anthelmintic.

Copernicia.

The genus numbers 9 species spread over Brazil, Venezuela, Argentine, San Domingo, Cuba and New Granada.

Copernicia cerifera Mart., Brazilian Wax Palm, inhabits Brazil and is found in the Provinces of Bahia, Pernambuco and Piauhy. It is sometimes grown in Indian gardens.

The root is alterative and diuretic, and is in high popular esteem as a tonic and blood purifier.

Brazil: Carnauba—; *English*: Brazilian Wax Palm—.

Corypha.

The 6 species of this genus inhabit Tropical Asia.

Corypha umbraculifera Linn. The Talipot Palm is rather common in Ceylon in the moist low region below 2,000 ft. It is also met with on the Malabar Coast and in Kanara—in the moist forests of the Kumpta and Honavar talukas of Northern Kanara, covering extensive areas near the Gersoppa and Yena rivers, also on the Yellapur Ghats; sometimes planted in gardens near the coast. It extends to the South Andaman Islands, the Little Coco and the Great Coco. It is cultivated in tropical India and Burma.

The fruit is a fish poison.

Bengal: Bajarbattuler, Tali, Tallier, Tara, Tarit—; *Burma*: Pebin—; *Canarese*: Baini, Indu, Sritale, Sritali, Tali—; *English*: Fan Palm, Great Fan Palm, Holy Palm, Java Fan Palm, Malabar Coast Fan Palm, South Indian Talipot Palm, Talipot Palm, Umbrella Palm—; *Malayalam*: Kutappana, Sitalam, Talippana—; *Marathi*: Bajarbattu, Tali—; *Sanskrit*: Alpayushi, Karalika, Katakali, Pakti, Sritala, Tali—; *Sinhalese*: Tala—; *Tamil*: Kudaippanai, Sidalam, Talappam, Talippanai—; *Telugu*: Dridhatalamu, Sritalamu—; *Tulu*: Panoli—.

Elaeis.

The genus numbers 4 species, inhabitants of Tropical Africa and Eastern Tropical South America.

E. guineensis Jacq. is used medicinally in Equatorial West Africa and in Brazil; *E. melanococca* Gaertn. too is used in Brazil.

Elaeis guineensis Jack. The African Oil Palm is a native of Africa, cultivated in India.

In Guinea the oil from the sarcocarp is applied to wounds as a vulnerary. It is used as a liniment for rheumatism and courbature.

The Bubis of the Island of Fernando Po make an excellent poultice of the oil which they apply to wounds.

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In Equatorial West Africa the roots are used as a diuretic, and the fresh sap as a laxative.

Angola: Diholo—; *Bacongo*: Matebbe—; *Baffuru*: M'bila—; *Baga*: M'Bia—; *Banziri*: Bete—; *Brazil*: Coqueiro de Denté—; *Congo*: Leba—; *Dutch*: Afrikaansche awarra, Afrikaansche oliepalm, Obepalm, Oliepalm van Guinea, Oliepalm van West Africa, Oliepalm van de Kust van Guinea, Palmietboom—; *English*: African Oil Palm, Oil Palm, True Oil Palm—; *French*: Aouara d'Afrique, Aouara des Caraïbes, Aoura de Guinée, Aovora, Arouara des Caraïbes, Avoira de Guinée, Elaïs de Guinée, Eléide, Eléide de Guinée, Noix de palme, Noix de palmier, Palmier crocro, Palmier épineux, Palmier à huile, Palmiste épineux—; *Ga*: Ngmetsho—; *Gaboon*: Oila—; *German*: Afrikanische Oelpalme, Guineische Oelpalme, Oelpalme—; *Guinea*: Toehntis—; *Hausa*: Kwakwa—; *Malinke*: Tintulu—; *Nzima*: Arairlair—; *Pahuin*: Aline—; *St. Thomas Island*: Denden, Palmeira andim—; *Surinam*: Aaavora, Avoora, Avouara, Avuara, Maba, Obe—; *Susu*: Tugi—; *Twi*: Abair—; *Yakoma*: Zamba—.

Hyphaene.

This genus numbers 27 species distributed all over tropical and sub-tropical Africa, Arabia, and Western India.

Hyphaene thebaica Mart. The Egyptian Doum Palm grows along the valley of the Nile in Middle and Upper Egypt, and is to be met with at Shaik Othman near Aden. Old specimens may be seen in many a garden of India and Ceylon, and, as a rule, they are much better developed than the tree growing in Egypt.

The fruit is considered anthelmintic.

Diu Island: Okamundel—; *Egypt*: Mama—; *English*: Egyptian Doum Palm, Gingerbread Tree—; *Ewe*: Sokuti—; *Gold Coast*: Dum Palm, Gingerbread Palm—.

Licuala.

This genus comprises about 50 species inhabiting Asia, Australia and the Pacific Islands.

Licuala spinosa Wurmb. (=*Corypha pilearia* Lour.) is found in Malacca, common in wet places, particularly in hedges. It is also met with in the tidal forests of the Andamans, in the Nicobars and the Malay Islands.

In Cambodia the bark is used in combination with other drugs for the treatment of tuberculosis with spitting of blood.

Cambodia: Chak—; *Malay*: Plass—.

Lodoicea.

The genus is limited to 1 species endemic in two of the Seychelles Islands: Praslin and Curieuse.

Lodoicea seychellarum Labill., Double Cocoanut Palm.—The marvellous medicinal properties which are ascribed to the NUTS by ancient physicians, both European and Asiatic, have now been recognized as fanciful and due solely to the rarity of the fruit.

The water of the green fruit or its soft kernel is said to be antibilious and antacid when taken after meals. The ripe fruit is also used similarly, but is at the same time purgative.

The kernel is a tonic and stomachic. With rose water it is given in indigestion, diarrhoea, and for the relief of colic. In com-

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bination with other drugs it is made into a paste and applied to swollen glands.

In Southern India the kernel is given in woman's milk for the treatment of typhus fever. It is credited with antiscorbutic and antivenereal properties.

In Bombay it is prescribed as a tonic and febrifuge, and is used to check diarrhoea and vomiting, especially in cholera. It is also commonly given to children, mixed with the root of Nux-vomica, for colic.

The nut is in great repute among the Arabs as a tonic, preservative and alexipharmic.

The fibrous HUSK of the nut is used in the form of a decoction in the Tamil country. It is considered useful in reducing the quantity of sugar in the urine in cases of diabetes. Koman (1919) gave the decoction to two patients in the hospital with diabetes mellitus. The sugar eliminated decreased considerably, but did not disappear altogether. There was relapse as soon as the decoction was stopped.

Arabic: Narjilebahri—; *Bombay*: Jaharinaral, Jeharinaryal—; *Burma*: Pénle-on-si—; *Deccan*: Daryakanarel—; *Dutch*: Dubbele cocosnoot van de Seychelles, Dubbele Klapper, Maledivische noot, Seychellennoot, Zeeklapper—; *English*: Cocoanut of the Maldives, Double Cocoanut Palm, Sea Cocoanut Palm—; *French*: Coco de l'île Praslin, Coco des Echelles, Coco de mer, Coco de Salomon, Coco des Seychelles, Cocotier des îles Seychelles, Cocotier des Maldives, Cocotier des Seychelles, Cul de négresse, Double Coco, Lodoïce des Maldives, Lodoïcée, Lodoïcée des Seychelles, Lontar domestique, Rendier éventail, Rendier lontar, Tobel—; *German*: Doppelte Cocosnuss, Kokosartige Lodoicée, Maldivische Nuss, Meercocos, Seecocos, Wundernuss Salomons—; *Gujerati*: Daryanunariyal—; *Hindi*: Daryakanaryal—; *Indian Archipelago*: Calappalaut—; *Java*: Djenggi, Djenggli, Kelapalaut, Kepodjenggi, Pelokdjenggi—; *Malayalam*: Akraritennu, Kataltenna—; *Persian*: Nargilebahri—; *Portuguese*: Coco das Maldivas, Coco do Mar—; *Seychelles*: Coquinko, Tavacarre—; *Sinhalese*: Mudupol—; *Tamil*: Kadattengai—; *Telugu*: Samudraputenkaya—.

Loxococcus.

The genus is limited to 1 species endemic in Ceylon.

Loxococcus rupicola Wendl. and Drude is known in the vernacular as *dotalu*. Its seed is used for mastication with betel, like arecanut.

METROXYLON.

This genus comprises about 9 species, natives of the Malay Archipelago, New Guinea and Fiji.

1. Spikes 4-5 in. long, ½ in. in diameter ... ... *M. sagus.*
2. Spikes 2½ in. long of the size of the little finger ... *M. rumphii.*

1. **Metroxylon sagus** Rottb. (=*Sagus laevis* Rumph.). The common Sago Palm is to be found in the entire group of the Moluccas, and in Borneo, Sumatra, Java, the Philippine Islands, the Malay Peninsula; chiefly cultivated.

The fruit is used as a poison in Malaya.

Dutch: Meeboom, Meelgevende palmboom, Moluksche palmboom, Sagoboom, Sagoeboom, Sagopalm—; *English*: Common Sago Palm, Rumphius's Sago Palm, Sago Palm, Sago Tree—; *French*: Arbre au sagon, Palmier du Japon, Palmier sagon, Sagonier, Sagonier farinifère, Sagoutier—; *German*: Echte Sagopalme, Molukkische Sapfenpalme, Rumph's Sagopalme, Sagobaum, Sagopalme—.

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2. **Metroxylon rumphii** Mart. (=*Sagus rumphii* Willd.) is distributed throughout the Malay Archipelago.

The fruit is used as a poison by the Malays.

English: Rumph's Sago Palm—; *Malay*: Sagu—.

Nannorhops.

The genus is limited to 1 species distributed through Sind, Baluchistan, Punjab and Afghanistan. It is abundant in the Peshawar Valley, in Kohat and in the trans-Indus territory along the eastern skirts of the Suliman range, ascending up to 3,000 ft. Also very common on the hills which form the western boundary of Sind. It is common locally on a limited area in the central Salt Range, between 2,000 and 5,000 ft. and on Mount Sakesar. In one place in the Siwalik tract east of the Jhelum, near Sumani above Bhimbur. It is common in the Khaiber Pass, and generally in the low arid mountains of eastern Afghanistan. It is found everywhere up to 5,000 ft. in Baluchistan and Makran, except near the coast.

Nannorhops ritchieana H. Wendl. is a low gregarious shrub, the leaves usually tufted from an underground, much-branched rhizome.

The young leaves are given in diarrhoea and dysentery. They are also purgative, but chiefly used in veterinary medicine.

Bangash Hills: Fiesch—; *Barkhan*: Dhora, Mazari—; *Duki*: Dhora, Mazari—; *Hindi*: Mazari, Mazri—; *Jhalawan*: Pish—; *Kohlu*: Dhora, Mazari, Pish—; *Musa Khel*: Dhora, Mazari—; *Pushtu*: Maizurrye—; *Salt Range*: Kalium, Kilu—; *Shahrig*: Dhora, Mazari, Pish—; *Sibi*: Dhora, Mazari, Pish—; *Sindh*: Dhora, Fease, Pease, Pesh, Pfarra, Phana, Pfis—; *Trans-Indus*: Mazari, Mazrai, Mzarai—.

Nipa.

The genus is limited to 1 species which covers thousands and thousands of acres of the salt marshes of the islands and coasts of the Indian Ocean. It inhabits the river estuaries and tidal forests of the Sunderbans, Chittagong, Burma and the Andamans, and extends throughout Malaya to Queensland. Its Western limit is Ceylon where it is to be found at the mouth of rivers on the south-west coast, Kalutara, Gindura River near Galle.

Nipa fruticans Wurmb. The Nipa Palm is used medicinally in the Philippine Islands.

The fresh leaves are much used in the treatment of ulcers in the form of cataplasm or lotion. They are considered a valuable remedy for the bites of centipedes.

The alcohol obtained from the toddy by distillation is mixed with water and used as an eye wash in inflammations of the eyelids and of the conjunctiva.

Andamans: Poothada—; *Bengal*: Gabna, Gulga—; *Burma*: Dane—; *Cagayan*: Tata—; *English*: Nipa Palm, Water Cocoanut—; *Guam*: Nipa, Sasa—; *Gujerat*: Paradeshitadio—; *Hindi*: Gulga—; *Philippines*: Lasa—; *Ponape*: Parrau—; *Sinhalese*: Gimpol—; *Sulu Archipelago*: Ballang—; *Tagalog*: Nipa, Sasa—; *Telugu*: Kotitikaya, Nipamu—; *Zambales*: Saga—.

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Phoenix.

The genus consists of about 12 species which inhabit sub-tropical Africa and Tropical Asia.

Four of the species are credited with medicinal properties.

1. Leaves 2-6 ft. long	*P. pusilla.*
2. Leaves 8-10 ft. long	*P. paludosa.*
3. Leaves 10-15 ft. long	*P. sylvestris.*
4. Leaves longer	*P. dactylifera.*

1. **Phoenix pusilla** Gaertn. is to be found on the Coromandel Coast, not far from the sea, and in the dry forests of the northern part of Ceylon.

The fresh SAP is cooling and laxative.

The GUM is used in diarrhoea and in genito-urinary diseases.

The FRUIT is prescribed in cough, asthma, fetid breath, also in fever and gonorrhoea.

The SEEDS are made into a paste by trituration with water and applied over the eye in inflammations and for opacity of the cornea.

Canarese: Hullichala, Ichalu, Sannayichalu—; *Ceylon*: Inchu—; *Hindi*: Palawat—; *Malayalam*: Chittintal, Inta—; *Tamil*: Ichu, Indu, Inju, Kalangu, Kurinji, Sagi, Siruyinju, Sittinju—.

2. **Phoenix paludosa** Roxb. The Wild Date Palm is tolerably common throughout India, wild or more often cultivated. It forms siderable portion of the impenetrable woods which cover the Sunderbans. It is met with along the Selwin, between Amherst and Moulmein, and extends to Penang, Siam and Cochin China.

The fruit is acidulous, sweet and cooling. It relieves flatulence and assuages pain. It is given in fever and inflammation.

Bengal: Golpatta, Hintal, Hital—; *Burma*: Thinboung—; *Hindi*: Hintal—; *Penang*: Dangsa—; *Sanskrit*: Hintala—; *Telugu*: Giruka tati, Hintalamu—.

3. **Phoenix sylvestris** Roxb. The Wild Date Palm is tolerably common throughout India, wild or more often cultivated. It forms extensive forests in Rohilkhand, on the low ground along the Ramganga River, and on the plateau of Mysore, between Shimoga and Tumkur, in the moister stretches of low ground which intersect and drain the rocky undulating granite hills. It is most abundant in Bengal, Behar, on the Coromandel Coast and in Gujerat. In the Bombay Presidency it is common in moist ground throughout the dry districts, usually along banks and in the beds of streams and watercourses. It is not uncommon in the Siwalik tract and the outer Himalaya, reaching up to 5,000 ft. in Kumaon. It is met with at Ghiaunla in Garhwal at 3,500 ft., along the banks of the Bias above Mandi, in the Jamu hills at 2,000 ft. elevation, and in the Salt Range.

The ROOT is given for toothache.

The fresh TODDY is considered a cooling drink.

The FRUIT is prescribed in gonorrhoea and gleet.

The fruit, pounded and mixed with almonds, quince seeds, pistachio nuts, spices and sugar forms a very popular restorative remedy.

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A paste, formed of the KERNELS and the root of *Achyranthes aspera*, is eaten with betel-leaves as a remedy for ague.

Bengal: Kajar, Kejur—; *Berar*: Seindi—; *Bombay*: Khajur, Khajura, Khajuri, Sendi—; *Canarese*: Andadayichalu, Ichala, Ichale, Ichalu, Ichela, Ichil, Kallichalu, Kallu, Siyindu—; *Deccan*: Sandolekanar—; *English*: Date-sugar Palm, Indian Wine Palm, Sugar Palm, Wild Date Palm—; *Gond*: Sindi—; *Gujerati*: Kajuri, Kharak, Tadi—; *Hindi*: Kejur, Khaji, Khajur, Khajuri, Salma, Sendhi, Thakil, Thalma—; *Kolami*: Khajur—; *Konkani*: Kajuri—; *Malayalam*: Inta, Intappana, Kattinta—; *Marathi*: Boichand, Sendri, Shindi, Sindikajuri—; *Mundari*: Darukita, Kitadaru—; *Porebunder*: Khalelananjhad, Tadi—; *Punjab*: Khaji, Khajur—; *Sanskrit*: Bhumikharjurika, Durararoha, Dururuha, Dushpradarsha, Haluka, Haripriya, Kakakarkati, Kapila, Kashayi, Kharju, Kharjuri, Mriduchhada, Nishreni, Skandhappala, Svadi, Svadumastaka, Yavaneshta—; *Santal*: Khijur—; *Tamil*: Ichambanai, Inju, Karavam, Kattinju, Madal, Periyayinju—; *Telugu*: Ita, Peddayita—; *Uriya*: Khorjuri, Khorjuro—.

4. **Phoenix dactylifera** Linn. The Edible Date Palm is cultivated and self-sown in Sind and in the Southern Punjab, particularly near Multan and Muzaffargarh, also in the Sind Sagar Doab and trans-Indus territory. Near Dehra Ghazi Khan, date-palms are very numerous on a strip 10-12 miles long from north to south. A few trees are found planted at many places in the Eastern Punjab, also at Saharanpur, and here and there in the Ganges Doab and Bandelkhand. It is also grown in the Deccan and Gujerat, but does not thrive in Bengal. It thrives luxuriantly in the arid rainless regions of North Africa and West Asia, where it is exposed to extreme heat in the daytime, and not uncommonly to frost at night, but it requires a certain amount of moisture in the soil. In Europe it is cultivated in Spain, on the Hyères Islands, the Riviera near Nice, San Remo and Genoa, where it attains its northernmost point. There is a wood of date-palms at Bordighera near San Remo, said to contain over 4,000 stems cultivated mainly to yield palms for Palm Sunday at Rome. In South Italy, Sicily and Greece, the tree is not uncommon, but the fruit is small and poor.

The tree yields a GUM which is considered a demulcent, diuretic and refrigerant. It is esteemed in the Punjab as a valuable remedy in diarrhoea and diseases of the genito-urinary system.

When the heart of the LEAVES is cut out a sweet thickish fluid collects in the cavity, which is very refreshing and slightly purgative. Yunani practitioners use the leaf as an aphrodisiac and prescribe it in liver complaints.

The fresh SAP is cooling and laxative.

The FLOWER is bitter. The Mahommedans say it is purgative, expectorant and tonic to the liver; they recommend its use in fever and blood diseases.

The fresh FRUIT is considered demulcent, expectorant, laxative, tonic and diuretic. But a long continued use is said to produce soreness of the gums. Water in which fresh dates have been steeped for a while is given to relieve alcoholic intoxication. Milk in which clean and fresh dates have been infused is a very nourishing and restorative drink especially during convalescence from fevers and small-pox.

Dates are said to promote expectoration, soothe the chest and also prevent constipation. They are prescribed in cases of cough,

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asthma, consumption and generally for all kinds of chest troubles. They are also given in fever, gonorrhoea, liver complaints and abdominal troubles; and they are recommended for the treatment of dysentery.

The dried fruit, pounded and mixed with almonds, quince seeds, pistachio nuts, spices and sugar, forms a much esteemed restorative. It is also used as an ingredient in various tonic and aphrodisiac preparations.

In Southern India the ground SEEDS are made into a paste by trituration with water and applied over the eyelids for opacity of the cornea. The paste is also said to be efficacious in relieving headaches and hemicrania.

A fine paste made of the seed of the date-fruit and the root of *Achyranthes aspera* is applied to betel-leaves and made into little packets together with clove, cardamom, catechu and arecanut. Three packets are administered at intervals of one hour before an expected attack of ague.

The smoke from the burning powdered seeds affords great relief when used as a fumigant for piles.

Arabic: Nakhleh—; *Badaga*: Gajjira—; *Bengal*: Khajur—; *Bhote*: Khasser—; *Bombay*: Khajur—; *Burma*: Sunbalun, Swonpalwon—; *Canarese*: Kajura, Karika, Karjura, Kharjura—; *Chinese*: Wu Lou Tzu—; *English*: Arabian Date Palm, Cultivated Date Palm, Edible Date, Large Date, Persian Date—; *French*: Dattier, Dattier cultivé—; *German*: Dattelbaum, Dattelpalme—; *Greek*: Phoinix—; *Gujerati*: Karek, Khajur—; *Hebrew*: Chhomer, Tomer—; *Hindi*: Khaji, Khajur—; *Italian*: Dattero, Palma—; *Kachhi*: Khaji—; *Kej*: Abdandan, Abraughan, Amiri, Anguro, Arrasht, Bambai, Banduk, Barni, Barral, Bingu, Buledi raughani, Burshakri, Buzband, Chafshak, Charpan, Dashtari, Gognai, Gozti, Gundgoreg, Gurbagu, Gwazo, Haleni, Husaini, Jafash, Jafshakjalgi, Jamsaki, Jowanabushmas, Johanajaski, Jozo, Kalerak, Kalunti, Karpaso, Khargi, Khurmazard, Kohijalgi, Kuleri, Kuzanabat, Mairisurkh, Makli, Mataftaza, Mulkijalgi, Nazamdazi, Nazantabaqi, Nazbibilanguk, Naznin, Pandi, Peshnai, Pingu, Pull, Ragom, Baughani, Santgwaragh, Shagashkhand, Shipga, Siahkanok, Sohri, Subrebegamjangi, Tigal, Ushtarkor, Wakhshi, Washkalunt, Washkung, Washnao, Zard—; *Kohhaja*: Mach—; *Malayalam*: Itta, Ittappalam, Tenitta—; *Malta*: Palma, Palma da datteri, Palma tattamar—; *Marathi*: Kharjur—; *Nasirabad*: Khajji, Khurma—; *Nushki*: Mach—; *Panjgur*: Begamjangi, Dandari, Dashtlafashsabzo, Fard, Fofo, Haraksabzo, Hussainizard, Joshandakalut, Joshandasabzo, Khurmakarmachi, Khurmaikalut, Kungo, Mozawati, Rabi, Radag, Zardan, Zardpanjguri—; *Portuguese*: Palmeira, Tamareira—; *Punjab*: Khaji, Khajur—; *Pushtu*: Kajura, Shewa—; *Roumanian*: Curmal—; *Russian*: Phinikovoe dyerevo—; *Sanskrit*: Dipya, Hayabhaksha, Madhurasraoa, Mudarika, Phalapushpa, Pindakharjura, Pindakharjurika, Pindiphala, Rajajambu, Sapinda, Svadupinda—; *Sharig*: Khajur—; *Sibi*: Khajji, Khurma—; *Sind*: Kaji, Kurma, Pindchirdi, Tar—; *Sinhalese*: Ind—; *Spanish*: Datilera, Palma datilera, Palmera—; *Swedish*: Palmtrae—; *Tamil*: Ichu, Inju, Karchuram, Kuravam, Perindu, Perinju, Titti—; *Telugu*: Gajjuramu, Ita, Kharjuramu, Manjiyita, Muddakharjuramu, Peridu, Perita, Simakharjuramu—; *Turki*: Karmah—; *Urdu*: Khurma—; *Uriya*: Khorjjuri—; *Waziri*: Khajurra—.

5. According to the authors of the Encyclopaedia Mundarica *Kindad* is a stemless palm different from *Kita* (=*Phoenix acaulis* Buch.). The pinnae of its pinnatisect leaves are shorter and recurved at the end, they spread at a much greater angle to the axis than the pinnae in an *otekila* leaf.

The root-stock is pounded and thrown into pools and rivers to poison fish.

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6. *Kitamuli* is said to be a stemless palm, different from *Phoenix acaulis* Buch. It has only two plicately multifid leaves like those of the male *acaulis*, and is said to die after two or three years. Its corm is slender having the size and form of a carrot, and containing nevertheless a farinaceous substance.

The mealy substance of the corm, edible in the *Kita*, is deadly poisonous in the *Kitamuli*. It acts as a vesicant and is, therefore, applied to the chest in pneumonia. It is also rubbed on the herpetic eruptions called *dinai*.

Pinanga.

This genus numbers about 50 species distributed over the Indo-Malayan region.

Pinanga dicksonii Bl. (=*Areca dicksonii* Roxb.) is found in great abundance on the mountains of Travancore and Malabar. It is gregarious and locally abundant in the evergreen forests near the Gersoppa and Nilkund Ghats of Northern Kanara.

The poorer classes eat the nut as a substitute for the common arecanut.

The dried husk of the fruit is used medicinally in China, Japan and Annam. It is in much request in flatulent, dropsical or obstructive diseases of the stomach. It is also given in choleraic affections.

China: Ta Fu Tzu—; *Malayalam*: Kanakamuka—; *Telugu*: Kondapoka—.

Raphia.

This genus numbers about 20 species which inhabit Tropical Africa and America.

Two of them are credited with medicinal properties.

1. Leaves rising straight up ... ... *R. ruffia.*
2. Leaves rising nearly vertically from the stem, bending out on every side in curves, forming a plume *R. vinifera.*

1. **Raphia ruffia** Mart. (=*R. pedunculata* Beauv.=*Sagus ruffia* Jacq.) is indigenous in Madagascar. It is extensively cultivated on the Mascarene Islands and naturalized in America.

The ROOT is given for toothache.

The fresh JUICE is a valuable laxative.

Dutch: Madagascarsche sagoboom, Sagodragende palm—; *English*: Raffia, Raffia Palm, Rafia Palm, Raphia Palm, Roffia, Roffia Palm—; *French*: Mouffia, Palmier de Mayotte, Raffia, Rafia, Raphia—; *German*: Bambuspalme, Madagaskarische Sagopalme, Raffiabastpalme, Raffiaweinpalme—; *Hova*: Rafia, Rofia, Voarafy—; *Madagascar*: Fomby, Maivanaty, Raofia.

2. **Raphia vinifera** Beauv. The Wine Palm grows in communities in the freshwater swamps of Lower Nigeria.

The SEEDS contain a bitter oil which in Guinea is much used for courbature and rheumatic pains.

In the Gold Coast the pounded seeds are thrown in pools and rivers to stupefy the fish.

Aowin: Dongkang—; *Ashanti*: Adobair—; *Awuna*: Alati—; *Dutch*: Raphiavezelpalm—; *English*: Bamboo Palm, Jupatic Palm, Pharaoh's Date-palm, Wine Palm—; *Ewe*: Ala—; *Fanti*: Adobair—; *French*: Bourdon, Palmier à vin,

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Raphier—; *Ga*: Adobair—; *German*: Bambuspalme, Echte Weinpalme, Weingebende Sagopalme, Weinpalme—; *Krepi*: Adoka, Altai—; *Krobo*: Sowaircho—; *Malinke*: Ban—; *Nizima*: Dorka, Eduiri—; *Quittah*: Adoka—; *Twi*: Adobair—; *Wassaw*: Tombo—.

TRACHYCARPUS.

The genus consists of three species inhabiting the Himalayas, China and Japan.

Trachycarpus excelsa H. Wendl. (=*Chamaerops excelsa* Thunb.) Fortune's Chusan Palm is found in Upper Burma and extends through Yunan to China and Japan.

The FRUIT is astringent.

Chinese: Tsung Lu—; *English*: Fortune's Chusan Palm—.

WALLICHIA.

The genus numbers three species which inhabit India and Malaya.

Wallichia disticha T. Anders. occurs in the Gonda Hills of Oudh, the valleys of Sikkim Himalaya to 2,000 ft., the Makum forest in Assam. It is found in Upper Burma ascending to 4,000 ft. in the hills east of Bhamo, and on the Pegu Yoma, chiefly on the eastern slopes.

The BERRIES irritate the skin.

Lepcha: Katong—; *Lower Burma*: Letme, Zanaung—; *Upper Burma*: Minbaw—.

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SNAKES IN BELGAUM.

BY

Lt.-Col. K. G. Gharpurey, I.M.S.

I had written a small note in the *Bombay Natural History Society Journal* of 15th July, 1930 (vol. xxxiv, No. 2, p. 585), on 'Snakes collected at Belgaum', in which 18 snakes seen by me there in 1927-1928 were mentioned. Of these, 3 were Phipson's Earth Snake, 5 common wolf snakes, 7 green keelbacks, 2 common Rat snakes or dhamans, and one Russell's Viper. This number was too small to find out the common species seen there. I happened to be re-posted to Belgaum again as Civil Surgeon in the rains and I started collecting snakes there as the rains bring them out in numbers. I saw and identified 65 snakes in six months from August 1933 to February 1934. The collection was interesting in that more species were seen than those in my previous note and I came across half a dozen cases of snake-bite also. Of the snakes seen 8 were cobras, so my remark at the end of my previous note, that cobras are not common does not hold good. Only few of the snakes were from the district, most of them being from Belgaum itself or its vicinity within a few miles. Of the 65 that were seen, 21 were poisonous (8 cobras, 6 common kraits and 7 Russell's Viper), nearly 33 per cent.—rather a high percentage.

The species were:—

Family: *Uropeltidae.*

1. *Silybura phipsoni* or Phipson's Earth Snake—9. A very common snake seen in the earth in the gardens and compounds. It is considered double-headed by some as its tail end is truncated and sliced. It is also called a Mud Snake.

Family: *Colubridae.*

2. *Lycodon aulicus* or Common Wolf Snake—9. Infant specimens were seen in August, so the hatching month seems to be July.

3. *Macropisthodon plumbicolor* or Green Keelback—10. Two were seen bottled in spirit in the British Military Hospital and one in the Sardar High School. Most of the others were seen about the Civil Hospital and its compound.

4. *Zamenis mucosus* or Common Rat Snake or Dhaman—4. One was seen bottled in British Military Hospital and one in the Vaccine Institute. One killed on 23rd September 1933 was 74 in. long and on dissection was found to have eaten a small snake and a lizard. One, killed on 30th January 1934, was 69 in. long.

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5. *Zamenis fasciolatus* or the Fasciolated Rat Snake—2. Both these were small specimens 13 in. and 10¼ in. and were seen bottled in Sardar High School.

6. *Tropidonotus piscator* or the Chequered Keelback—1. It was 37 in. long and was shot in water. It had an olive-coloured back, flanked red due to the red laterite soil.

7. *Tropidonotus stolatus* or the Buff-striped Keelback or the Dandy Snake—3. One was preserved in the British Military Hospital and two were seen from the Fort, near the Superintending Engineer's bungalow.

8. *Coluber helena* or Trinket Snake—1. Seen also bottled in Sardar High School.

9. *Dipsadomorphus trigonatus* or Common Brown Tree-snake —1. Small specimen 13 in. long; killed near the Civil Hospital.

10. *Dendrelaphis tristis* or Seba's Bronze Back—1. This good specimen was sent from the District by Mr. Rowlands, D.S.P. It was 41 in. long.

11. *Dryophis mycterizans* or the Green Whip Snake—1. A fine specimen sent from the district by Mr. J. Harris, A.S.P. It was nearly 6 ft. long (71 in.).

12. *Bungarus caeruleus* or the Common Krait—6. Three were seen preserved in the British Military Hospital and one in the Sardar High School. Two were brought from the Military Dairy Grass Farm area about 2 miles from Belgaum, one male 37½ in. and a female 36 in. long.

13. *Naia tripudians* or the Common Indian Cobra—8. All were binocellate. Two were seen preserved in spirit in the British Military Hospital, nicely set up with the hood expanded showing the ocelli well. One was seen bottled in the Vaccine Institute. Two were killed in the Fort, both 57 in. long. Three were brought from the Military Dairy Grass Farm; two of these, biggish specimens, were lying together and brought on 27th January 1934, one being male 59 in. long and the other a female 60 in.

Family: *Viperidae*.

14. *Vipera russelli* or Russell's Viper—7. One was seen bottled in the British Military Hospital and one in the Vaccine Institute. Two were killed in the Military Dairy Grass Farm area, one 51 in. and one 42½ in. One was killed near the cookhouse of the Senior Officers' School Mess on 5th November 1933 and was 45 in. long.

One was killed on 19th November 1933 at Dupdhal, near Gokak. This one, 39 in. long, had bitten a P.W.D. cooly working in the grass in the late afternoon. Fortunately Mr. J. Brooks, District Forest Officer, was there. He gave prompt first aid and took the cooly in his car to the Gokak Mill Dispensary where the bitten person got intravenous Antivenene within an hour of the bite, and the man recovered completely without showing any symptoms. Mr. Brooks sent the snake also the same evening to me at Belgaum for identification.

Another one bit a person in the garden near the Hindalgi Jail about 12 noon on 1st February 1934. The snake was killed

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and brought to me at the Civil Hospital by the Junior Medical Officer who came on his motor-bike, got it identified as Russell's Viper returned with the Antivenene, and the bitten person received the injection within an hour of the bite and there was complete recovery.

Both these cases show that if people do not waste time but carry out prompt treatment, the bitten person has a very good chance of quick and complete recovery.

There is a village called Turgamatti about 2 miles from Belgaum, near which are acres of land belonging to the Military Dairy Farm where grass is stacked. These stacks are a good sheltering place for snakes. When one stack was nearly cleared, the men working there found a large number of snakes at the bottom. Only the big snakes were brought to me, some alive and these were 3 Cobras, 2 Russell's Vipers, 2 Kraits and 1 Dhaman, all except one being caught in the month of January.

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MISCELLANEOUS NOTES.

I.—A TIGER FEEDING ON A COW WHILE YET ALIVE.

With reference to the paragraph in the Review on Mr. Peacock's book at page 206 of vol. xxxvi, No. 1 of this *Journal*, 'Has anyone ever known a case, in India, of an animal being fed upon by a tiger when alive? That, surely, must be peculiar to the tiger of Burma.' Mr. M. Freeman of Madras relates for the information of the writer that in 1930, when in the Palni Hills at the small village of Pambarai some twelve miles from Kodaikanal, he was taken late one evening by the village munsiff to a cattle-shed. Inside two cows were lying dead, killed by tigers and partly eaten, while a third one was lying on its rear side with the whole of its right haunch eaten, and the stomach so torn that a portion of the bowel was protruding. This cow was alive, chewing the cud, and did not appear to be suffering greatly.

Proceeding at dawn next day with a shot gun in order to shoot the cow, and using an electric torch to give light into the shed, Mr. Freeman found himself facing a tiger, backed a few steps, and, as the animal came out and made off, fired at it with S.S.G.

It was then announced that there was another tiger in the shed, and this beast was killed as it rushed out by one shot from a .500 express rifle.

The first animal was then beaten out of adjacent cover and killed; these two beasts measuring 7 ft. 2 in. and 7 ft. 4 in. One of them a female.

It was found that during the night the tigers had fed upon, and almost completely demolished, the live cow.

The uproar made by the villagers proceeding with the slain to the local temple roused a third tiger which Mr. Freeman wounded, and then killed by a shot in the chest as it bounded towards him.

The next morning the villagers brought to Kodaikanal the body of a fourth tiger, which they had managed to kill, after watching it go into the cattle-shed. They hammered a big stake in the doorway to keep it closed and shot the tiger by the light of a lantern lowered through a hole in the thatched-roof.

Mr. Freeman does not note the size of these two other animals, or whether either of them was mature, so it may be that all four were immature. If this was so, possibly they had been deprived early in life of their mother and been forced to feed themselves without the usual tuition in expert methods of killing.

This instance, the first heard of by the writer during a residence in India of forty-five years, and the first to be recorded in the pages of the *Journal of the Bombay Natural History Society* during the half century of its publication, is not of the kind referred to by the author of *A Game Book for Burma*. It is within the experience of many sportsmen, past and present, in Burma, that a

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full-grown able-bodied tiger not infrequently commences eating while the animal brought down by its attack is still alive.

The instance now noticed is of immature animals acting in this way, and must be, even in that case, a very exceptional occurrence.

COONOOR. R. W. BURTON.
October 25, 1934.

II.—RECORDS OF SOME CLOUDED LEOPARD (*NEOFELIS NEBULOSA*) IN THE DARJEELING DISTRICT.

(*With a photo*).

1. January, 1920. 3,000 ft., near Kurseong. Length of mounted skin 6 ft. 9½ in. Upper canines outside 1¾ in. Breadth of skull 4¾ in. Male.

2. January 1920. Same place as No. 1. Length of mounted skin 6 ft. 5½ in. Upper canines 1½ in. Breadth of skull 4½ in. Male.

Clouded Leopard (*Neofelis nebulosa*) in Darjeeling District.

Both these animals were shot in the same beat by one gun, as they came out together.

3. May 1926. Same place as No. 1 and 2. Male. Shot over a goat kill. All Nos. 1, 2 and 3 were full-grown with grey rather than fulvous predominating and appeared to be in their prime.

4. August 22, 1926. Runjeet Valley, 2,500 ft. Length 5 ft. 5½ in. Weight 42½ lbs. Male. Shot in a beat in *sal* jungle.

5. December 23, 1926. Runjeet Valley, 2,500 ft. Greyish. Head and body 3 ft. 1 in. Tail 2 ft. 6 in. Weight 48½ lbs.

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Height at shoulder 21 in. Girth of fore-arm 9½ in. Male. Picked up dead after an all-night fight with another leopard, species unknown. Greyish. Photo enclosed.

6. February 2, 1928. By the side of the Runjeet River, 1,000 ft. A favourite haunt of jungle fowl. Length 4 ft. 8 in. Weight 39 lbs. Male. About 10 in. had been severed from the end of the tail. Shot up a tree. A rich fulvous with whitish underparts.

7-8. October 1932. Two females length 5 ft. 6 in. and 5 ft. 1 in. respectively found dead side by side at the foot of a 100 ft. cliff by the side of a side stream of the Teesta River. 2,000 ft.

9. May 12, 1934. Above Rungbee. Teesta Valley, 2,000 ft. Very old female found dying and killed off by dogs. Skull sent to the Society for examination. Skin very greyish with poor markings.

W. H. MATTHEWS.

NAMRONG,
RUNGLI RUNGLIOT P.O.,
N. BENGAL.
August 19, 1934.

III.—NOTE ON A BEAR AND A PANTHER OBTAINED BY COL. F. M. BAILEY FROM TIBET AND A PANTHER FROM ASIA MINOR OBTAINED BY MR. J. E. WHITTALL.

The following supplement to my accounts of the Asiatic Panthers and Bears published respectively in the *Journal of the Bombay Natural History Society*, xxxiv, pp. 64-82, 1930 and xxxv, pp. 771-823, 1932, is based upon the skins of two rare panthers and the skin and skull of an equally rare bear recently received at the Natural History Museum.

One of the panther skins was most generously presented to the Museum by Col. F. M. Bailey who, while recently in Kashmir, received it from a Tibetan with the information that it came from near Shigatse, south of the Brahmaputra, some 100 miles north of Sikkim, a district from which no panther, so far as I am aware, has as yet been recorded. It is clearly a winter skin and is one of the most beautiful I have handled. The coat is full and long, about 45 mm. or 1¾ in. in length. The ground colour is rich orange yellow, paling to buff on the paws and low down on the flanks where the tint passes into the white of the belly. Everywhere on the upper side the under hair is dark smoky grey to a height of about 19 mm. from the skin. The pattern consists of rather close-set, medium-sized black rings not broken up into spots.

I am at present unable to distinguish this panther from the race I described in this *Journal* as *Panthera pardus bedfordi*, the original example of which came from S.-E. Shensi. But the discovery of this panther south of the Brahmaputra suggests that it may possibly extend its range to the northern slopes of the Himalayas which would bring it within the precincts of the Fauna of British India. The skull of the Tibetan specimen was unfortunately not preserved.

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The second panther skin is of a very different kind. It belongs to the Asia Minor race *Panthera pardus tulliana* of which, as recorded in my paper, the Museum had previously only a single skin in a poor state of preservation, collected many years ago in Anatolia. The new skin came from the mountains near Karajahissav, South-East of Kuluk in South-West Asia Minor and was kindly presented to the Museum by Mr. E. H. Givand at the request of Mr. J. E. Whittall of Constantinople with whom I had been in correspondence regarding the Museum's requirements in the way of mammals from Asia Minor. This panther is a particularly important addition because, as I learn from Mr. Whittall, it is now very rare.

The skin is in summer coat, the hair being short and sleek; the colour of the median dorsal area is ochreous buff gradually fading on the flanks and limbs and passing into white on the belly and into cream or buffy white on the paws; the tail is pale with some buff alongside the spots on the basal half, the terminal portion being grey; the hairs in the terminal third of its length gradually lengthen and are long at the tip; the pattern consists of well-spaced annular rosettes, mostly broken up into spots. This skin is paler in colour and shorter in the coat than the skin from Anatolia and was evidently killed at a different time of the year.

The Tibetan Bear is an example of the so-called Snow Bear (*Ursus arctos pruinosus*). The condition of the coat which is long, thickened with abundance of underwool and tufted suggests that the animal was killed soon after emerging from winter quarters. The general colour is black, showing dark brown patches of underwool when the hair is parted; but the tips of the hairs of the crown, nape, on each side of the shoulder mat and on the middle of the back are extensively yellowish tawny; this tawny hue dies away on the hind quarters and the hairs of the flanks are only faintly tipped with grey. There is a dirty white collar extending from the breast up the sides of the neck but not passing over the nape. The face and cheeks are tawny-brown and there is a good deal of tawny on the chest behind the fore legs, which like the hind legs are black. The claws are 'horn-coloured' and the toe pads are not united as described by Lönnberg.

This skin being in dead coat entirely lacks the coppery or silvery lustre I described in connection with Fenwick Owen's skins from W. Kansu which were collected in October.

The following are the dimensions of the skull in English inches and of the teeth in millimeters.

In English Inches.						In millims.			
Total length	Cond. basal. length	Zygom. width	Mastoid width	Int.-Orb. width	Max. width	Last 3 upper teeth	Last upper tooth	Last 4 lower teeth	Penult. lower tooth
14·7	13·8	8·1	6·5	1·1+	3·1	7·7	37 × 21	91	28 × 16

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The general conformation of the skull and the open basioccipital suture show that it had not reached full size but in total length it is only about 3 mm. shorter than the longest entered in my table, which was recorded by Leche, and it would certainly have surpassed the latter considerably, when full grown. The zygomata are narrower; but that is a matter of age. The teeth are actually and relatively small, the length of the last upper molar, 37 mm., coming between the two smallest examples of this tooth recorded in my table, namely those of the ♀ from Kansu, 39 mm., and the ♀ from North-East of Lhasa, 35 mm.

BRITISH MUSEUM (NATURAL HISTORY),
LONDON.

R. I. POCOCK, F.R.S.,
(*Unofficial Assistant in Zoology Department.*)

IV.—WILD DOG (*CUON DUKHUNENSIS*) KILLED BY DOMESTIC DOGS.

A wild dog was killed by two dogs owned by a friend of mine Mr. H. Vaughan Arbuckle on the neighbouring Estate of Sirikundra last month.

Mr. Arbuckle's dogs are a beagle from Ceylon, and a small cross bred Airdale—Irish Terrier. The latter is an exceptional game little devil with a predominance of Irish blood and they both spend a good deal of time hunting anything that runs from Civet cats to deer.

Mr. Arbuckle was in a field of tea superintending plucking coolies when his dogs started kicking up a terrific racket close to him. Before he could get to them they started to run and after a very short hunt he came up with them mixed up in a rough and tumble with a wild dog which they were just finishing off. The wild dog was about three-quarters grown, his testicles having not long dropped. I saw the skin subsequently myself but unfortunately it was not cured and has since decomposed.

It seems incredible that a wild dog with his great speed should not be able to get away from domestic dogs if he wanted to. When finally killed he was in a pretty good mess and it was very difficult to sort out his injuries, but Mr. Arbuckle advances the theory that his two dogs probably ham-strung him in one leg by a lucky bite when they first bayed him in the tea. The two dogs came out of the scrap with very little damage in which they must have been extremely lucky.

There is a considerable amount of virgin evergreen forest and Cardamom jungle round the boundaries of Sirikundra Estate which contains a lot of sambur and barking deer and wild dogs are constant periodical visitors. For some time past there has been a pack of four dogs hanging about, a large dog, a bitch and two small dogs presumably her pups. In all probability, the dog killed, was one of these pups which was very likely either sick or

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had been damaged in a hunt and was lying up asleep in the tea when it was surprised.

MONICA ESTATE, J. WILLIAMS.
VALPARAI P.O.
August 31, 1934.

V.—TIME OF SEXUAL MATURITY OF THE ELEPHANT (*ELEPHAS MAXIMUS* L.).

Mr. Gordon Hundley's very interesting letter of February 26, 1934 in vol. xxxvii, No. 2, records certain details regarding Burmese elephants which accord closely with facts recorded from South India. In Coorg, a Forest Department tusker named Krishna came into *musth* when his age was believed to be only 15 years. A Madras Forest Department cow elephant, Meenakshi, herself born in captivity, calved when she was only 13 years old, two years younger than the cow mentioned by Mr. Hundley. Meenakshi was the daughter, by a wild bull, of chik Lakshmi, who was the daughter of Lakshmi. Tradition has it that Lakshmi was a Burmese elephant transferred from the Commissariat Department. Meenakshi's son referred to above, Dosti Jehan, was a muckna, and being also precocious like his mother, was a father at 20, his son Abdul Ali being a tusker. The last-named is now 11 years old, so before many years the Forest Department may expect the arrival of the sixth generation of this family.

SALEM. G. C. ROBINSON,
September 6, 1934. I.F.S.

VI.—A BULL GAUR (*B. GAURUS*) AND A TIGRESS FIGHT TO DEATH.

I have read with interest Mr. W. S. Thom's Notes on Bison (*Bibos gaurus*) in Burma (vol. xxxvii, No. 1), in which he states 'Bison have only two enemies to fear, viz., tiger and man, but the former is no match for a full-grown bull'.

In view of this statement, the following may be of interest to readers of the *Journal*. In October 1931, on my return from leave, to my Forest Division, I was informed by some of my sawyers that about 10 days previous to my visit to their camp, they, whilst roaming about the forest, had come across the decomposed carcases of a bison and a tiger lying within 10 feet of each other. I visited the spot, and from what I saw, I was convinced that a battle royal had taken place, which had ended in the death of both combatants. For a radius of about 40 feet the jungle had been absolutely cleared, small saplings broken, and from the large trees chunks of bark had been torn off. The carcases were lying within 10 feet of each other, and on examining

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them I found that a tigress on one hand, and a bull bison in the prime of life on the other had been the combatants. The incident took place in the Makri Reserve on the Bastar State, C.P., which is a sanctuary for buffalo, bison and *barasingh*, and my statement can easily be verified by referring to the Forest Officer of the State, who enquired into the matter, and sent subordinates to inspect the spot.

CAMP BARDULLA,
MAINPUR P.O.,
Via RAJIM, B.N. RLY.
September 7, 1934.

H. V. BLACKBURN.

VII.—WHITE BISON.

In your issue of August 15, 1934, Mr. Morris has asked if I would refer to the appearance of these animals 'from a considerable distance' as being 'startling'. The answer is most emphatically 'yes'. It is for this reason that I made special mention of the variety in 'Wild Animals in Central India'.

I am probably as familiar as Mr. Wilson with the normal variations of colour, including light coloured animals. The bison however to which I referred do not come within this category, they are 'startling' different.

In my original description I referred to them as 'dormouse coloured'. Mr. Morris in his description calls them 'sandy or light fawn'. My point is that these are identical descriptions, as anyone who knows a dormouse will agree. We now get Mr. Wilson multiplying confusion by calling them 'a very light cream'. The above is evidence of the difficulty of describing a shade of colour in terms of language.

It is hoped that your Society will procure a skin from the Central Provinces and from Madras: it will then be possible to determine what difference if any, exists between specimens from these two parts of India. It is probable that a good many years may elapse before a C.P. specimen is secured. I base this statement on the fact that I have seen hundreds of bison on hundreds of occasions, all over the C.P., but only on very rare occasions have I seen a so-called 'white' variety. Your Society on procuring specimens could more precisely define the colour description, and possibly suggest a name.

I never suggested that they should be called 'Dormouse-coloured Bison' as Mr. Wilson implies, the nomenclature is far too clumsy to start with.

Mr. Morris makes a point over the adjective 'white' being applied to the Rhino: when that animal was christened sportsmen attached much less importance to scientific accuracy. Were the

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'White Rhino' discovered today, it would probably be called 'The Grey Rhino' and to my mind preferably so. In adopting therefore a specific name to a particular variety of bison, I would advocate, if possible some qualifying adjective, which is less of a misnomer than 'white'.

September 18, 1934. A. A. DUNBAR BRANDER.

VIII.—RATELS AND CORPSES.

I have read in your last issue a note under the above title from Mr. Dunbar Brander, in which he takes exception to my not having written to him personally before casting doubts in my recent book as to the accuracy of his statement that ratels are in the *habit* of exhuming corpses. Before answering what he writes I would like to say that I am a profound admirer of Mr. Dunbar Brander's excellent book, which I consider to be one of the best works ever published on the subject, and I am sorry to have caused him offence by disagreeing with just one of the statements contained therein.

He says that, as a self-appointed judge, I have confused the word 'exhume' with the word 'eat', but surely that is rather a quibble. If a ratel exhumes a corpse it is presumably not for the fun of doing so, or because he admires its pretty shape and appearance, but because he wants to eat it or the grubs that it contains, which is practically the same thing.

I wrote that 'So far as I am aware, no reputable naturalist has ever obtained first-hand evidence of such an act'. It would certainly have been better if I had used the word 'recorded' instead of 'obtained' but the purpose of a Journal such as this is to record observations on animal life, and I have found no such record either in this *Journal* or in any book that I have ever read. Hence it seems to me singularly unfortunate that Mr. Dunbar Brander could not have found space in his book or in a note to this *Journal* for the interesting experience that he now relates. However, 'better late than never' and he has now given a single instance of a ratel having exhumed a corpse, although, even so, it appears to have been a deduction only that a ratel was the culprit, with no actual eye-witnesses. It is also possible that some other readers of this *Journal* may be able to provide further isolated instances, but Mr. Dunbar Brander has quite failed to appreciate the whole point of my argument. What I wrote was 'an exceptional ratel may very rarely happen upon a corpse and sample it, but the exhuming of corpses is most certainly not a *habit* of this species'. I still stand by that statement until I am proved wrong; and it seems to me deplorable that a man with the vast experience of Mr. Dunbar Brander can dare to state as evidence, on the grounds that he has *once* come across a single case, that 'the name of grave-digger is *thoroughly-earned*, as I have known them exhume a (a single !) corpse. I once had to give evidence of this *habit*.

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The word habit means 'settled tendency or practice', and this 'self-appointed' and discredited judge is not prepared to accept one single instance during the long service of an experienced observer like Mr. Dunbar Brander as justification for the employment of the terms 'thoroughly earned' and 'habit' in evidence. Further, my book was essentially a book concerning the animals of the jungle and I do not spend my time outside my charge sitting in Mohamadan cemeteries trying to catch an odd ratel, probably desperate for food, trying to exhume corpses. My judgment is therefore 'not proved' as regards the charge that ratels are in the *habit* of doing this, although, as I wrote in my book, an exceptional ratel might be proved guilty.

As regards burrows, I think that Mr. Dunbar Brander's memories of the North Kheri forests must have become somewhat blurred since he retired. About two-thirds of the total area (I can give the exact figures if he likes) of these forests consist of an elevated plateau bounded by steep banks or 'damars', and the greater part of this plateau is not liable to flooding. It therefore affords excellent opportunities for good and dry burrows, particularly on the 'damars'. Yet, as I stated in my book, I never succeeded in finding an occupied burrow or den even in that favoured locality.

As Mr. Dunbar Brander remarks, it is impossible to say if the peculiar colouring of the ratel has been specially developed for protective purposes, but the subject is of great interest and I do not agree that the argument that the moon does not function continuously can be dismissed quite so easily as Mr. Dunbar Brander appears to assume. Perhaps he can tell us for what purpose ratels require protective or assimilative colouring?

I have been attacked in a Bombay newspaper for claiming that the ratel is the hero of the jungle and I have now been taken to task by Mr. Dunbar Brander for daring to disagree with him as to the justification for the insulting name of grave-digger. I am sorry that my humble effort to stand up for ratels has caused such a storm, but I do think it such a pity to give any wild creature a bad name without proof that the name is thoroughly earned. There is quite enough indiscriminate killing (apart from genuine sport) going on as it is without providing further excuses for destroying wild creatures.

In conclusion I would point out that, after all, neither Mr. Dunbar Brander nor I know much about ratels. It would therefore help if all readers of this *Journal* who are interested in the subject would send in any observations that they may have made, so that we may perhaps come to learn a little more concerning the habits of these most interesting creatures.

CAMP, *Via* ALMORA, F. W. CHAMPION,
U.P. I.F.S.
January 2, 1935.

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IX.—A HYBRID AMERICAN BISON AND DOMESTIC COW AT THE MYSORE ZOO.

(With a plate).

Thinking that it may interest your readers I am sending you a photo of a cross between an American Bison and a half-bred cow. The second photo shows the mother with the young one. In another two weeks we hope to have another similar one born at the Zoo.

SADEG Z. SHAH,
Assistant Secretary to the Maharaja of Mysore.

THE PALACE,
MYSORE.
October 2, 1934.

[The above is a result of some experiments in cross-breeding which are being carried out at the Mysore Zoo. Two previous attempts were made to cross American Bison with domestic cattle but unfortunately both the mother and young succumbed.—EDS.]

X.—THE LOCH NESS MONSTER.

The trouble is that most of the witnesses are utterly ignorant of nature and what to look for; they are only all at one, in being prepared to see a monster—and anything unusual is a monster. The evidence quite satisfies me that on a number of occasions a school of otters moving in single file, as they do, has been taken for the monster, each otter forming a hump. If I had been asked to guess what that photo was (knowing nothing of the monster) I would have said, 'An otter preaching in the water'. They can sit right up for an interval, like a dog begging, to look round, and imagine the leader doing this with perhaps half a dozen behind him, e.g. the monster. Last week a witness said it travelled in to the shore, and then along the shore in 6 inches of water for some distance, and had 6 humps; 7 otters obviously—the leader being the monster's head and the other 6 the humps. The photo was quite genuine and *bona fide* all right. There has been nothing published lately which at all indicates the real monster having been seen, but a very large grey seal was seen in the bay off Ness Mouth.

August 1934.

A. A. DUNBAR BRANDER.

[The above is an extract of a letter addressed to Mr. J. Ridland by Mr. Dunbar Brander.—EDS.]

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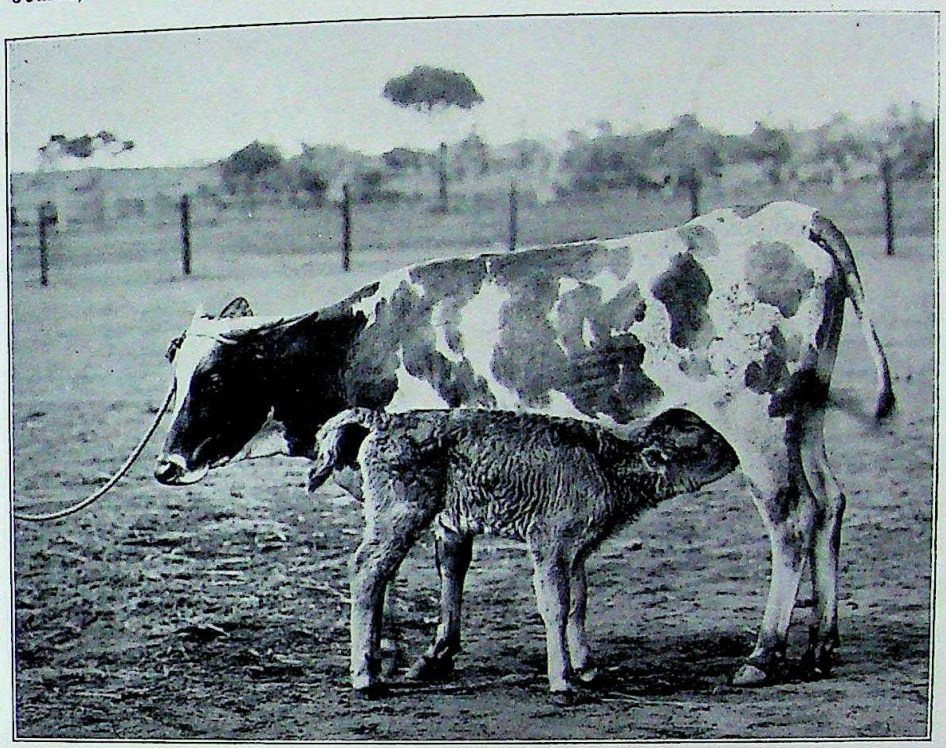
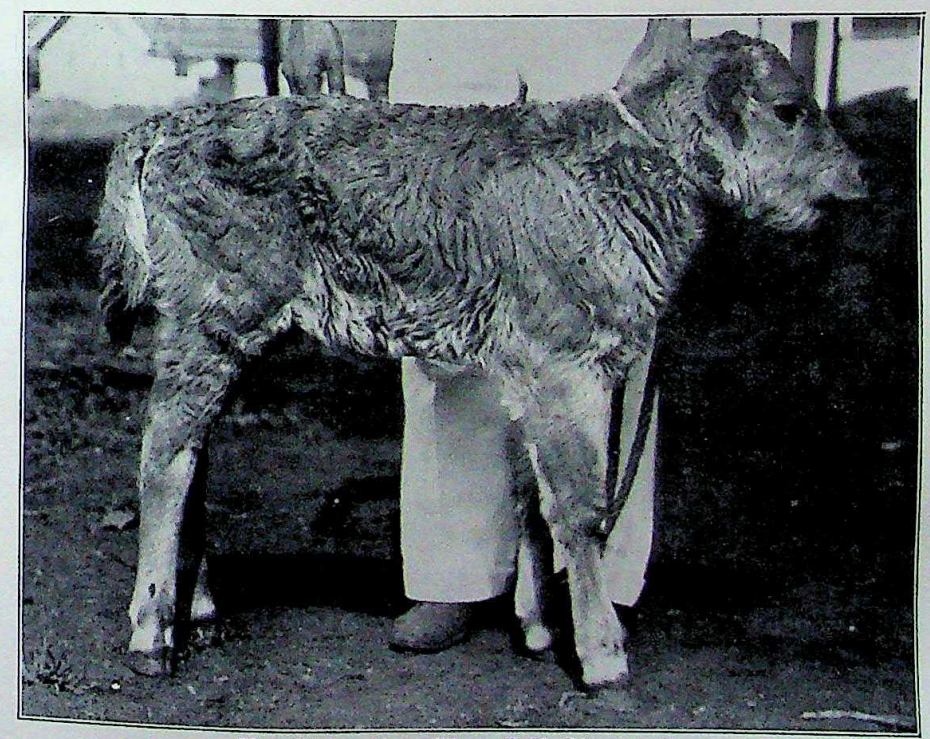


Hybrid American Bison Calf with parent half-bred cow.



Hybrid American Bison Calf, Mysore Zoo.

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XI.—OCCURRENCE OF THE BLACK-HEADED CUCKOO SHRIKE (*LALAGE SYKESII*, STRICKL.) IN THE HOSHIARPUR DISTRICT OF THE PUNJAB.

One of these Cuckoo Shrikes was obtained near Bharwain in the Hoshiarpur District on August 6, 1934 and another in the same locality on the following day. Bharwain (3,200 ft.) is situated on the crest of a range of the Siwalik foot-hills which here forms the boundary between the Hoshiarpur and Kangra Districts. Both birds were males with organs in breeding condition. Mr. Hugh Whistler, to whom they were sent, informs me that this is the first record of the bird in the Punjab, to which it had not previously been recorded nearer than Bareilly; it is probably a rains visitor.

AMBALA,
PUNJAB.
October 28, 1934.

H. W. WAITE,
M.B.O.U.,
Indian Police.

XII.—OCCURRENCE OF THE GREY-FRONTED GREEN PIGEON (*DENDROPHASSA POMPADORA AFFINIS* JERDON) IN THE KOLABA DISTRICT.

Blanford in the *Old Fauna* stated that the Grey-fronted Green Pigeon (*Dendrophassa pompadora affinis*) was to be found in the 'forests of Malabar from the neighbourhood of Bombay to Cape Comorin'. He discredited Jerdon's records from Central India and the Eastern Ghats.

Sinclair, reviewing Blanford (*J.B.N.H.S.*, vol. xii, p. 185), wondered what brought Bombay into Malabar, and recorded seeing a specimen shot in the Police Lines at Alibag, Kolaba District (North Konkan).

Barnes in his *Birds of Bombay* said it occurred in the Sahyadris as far north as Khandala.

On 25th February, while 'doing' Karnala Fort (Funnel Hill), Panvel Taluka, Kolaba District, with Messrs. N. Futehally and C. McCann, I saw several of these birds in heavy forest at about 1,000 ft., and later obtained a specimen on the road under the hill.

It would therefore appear that the 'Distribution' in the *New Fauna* 'West Coast of India from Kanara to Cape Comorin' stands in need of correction.

GODREJ HOUSE,
ANDHERI.
March 8, 1934.

HUMAYUN ABDULALI.

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XIII.—OCCURRENCE OF THE GREAT INDIAN BUSTARD (*CHORIOTIS NIGRICEPS*) NEAR SAUGOR.

I write to inform you that on Sunday, July 15, while out shooting blackbuck on the Dhana Ridge—a locality about 12 miles distant from Saguor East by E.S.E.—I and two friends spotted a Great Indian Bustard. It was stalked for about 10 minutes, and eventually shot with a rifle; it obviously saw its pursuer but would not take the trouble to fly, but rather seemed to prefer hiding behind such bushes as were there.

This took place at about 8-30 a.m., and the bird was eaten the next day. It had a very strong flavour (not 'gamey'), and was very tender.

As this bird is supposed to be very rare in these parts, I thought you might be interested to hear of its being seen and shot.

OFFICERS' MESS,
3/15th PUNJAB REGIMENT,
SAUGOR.
July 1, 1934.

E. P. DEEKS.

XIV.—ABUNDANCE OF THE FANTAIL AND PINTAIL SNIPE.

I send you these two observations on these two common snipe made by myself and confirmed by one or two friends and hope that they are original and interesting, and that they may be confirmed by shikaris in other parts of India.

(1) The incidence of snipe (Common, Fantail and Pintail) varies with the incidence of the Pintail, e.g., in a bad snipe year only few Pintail come over and in a good year many Pintail. Apparently Fantails are fairly constant in number each year.

(2) The last snipe to return are Pintail. At this time of the year they are usually mistaken for Fantails by the unwary as the pins have shed their fluff and this is usually not noticed. The other ordinary characters relied upon by the common or garden man i.e. the crochet hook top beak of the Pintail and the spatulate top beak of the Fantail however easily give away the birds.

PORAHAT FOREST BUNGALOW,
CHAIBASSA P.O., B.N. RY.
September 6, 1934.

P. W. AUGIER.

XV.—BIRD NOTES FROM BURMA.

The following I record, for what it is worth, from Burma.

1. A pair of Luggur Falcons breeding on a cotton tree (Letpanbin) on the Loikaw Plain, Karenni, South of S.S.S.

Have these falcons been observed east of this?

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2. I have seen the large solitary Cineraceous Vulture twice in Burma—once on the flat lands by the Taping River in the Bhamo District—and once on the high lands near Namkham on the Chinese border of the N.S.S.

It has not been recorded from Burma and Shelein.

3. A starling, species or race unknown, at Bhamo. This was a solitary bird feeding with the Mynas out on the flat lands south of Bhamo. In appearance it was exactly like the Starling of Kashmir.

TAUNGGYI, S.S.S.,
BURMA. T. R. LIVESEY.

September 14, 1934.

XVI.—A COMMENT ON 'THE NESTING HABITS OF THE SMALL SUNBIRD (*LEPTOCOMA MINIMA* SYKES) PUBLISHED ON PP. 730-732 OF THE *JOURNAL* VOL. XXXII.

Professor Nayar's breeding record of the Little Sunbird at Ernakulam is interesting. During my recent bird surveys of Travancore and Cochin I failed to come across this species in the low country along the backwaters and coast and found it confined to evergreen forest tracts commencing with the hummocky broken country further inland and extending up to about 5 or 6 thousand feet in the hills. Ferguson (*J.B.N.H.S.*, xv, 473) also found it common in the hills only.

As I had found both *Leptocoma asiatica* and *L. zeylonica*, especially the latter, common in the low country near the coast, I wrote to Prof. Nayar asking for confirmation of his record. In reply he states that he has no doubt as to the correctness of his identification since he is fairly familiar with both the Purple and the Purple-rumped Sunbirds and his note refers to neither of them. So far so good.

The next point is less clear. Mr. Nayar notes that the nest was examined by him on the evening of 11 February and found empty, whereas at 4-30 p.m. the next day it contained two eggs and that 'there was no doubt that the eggs were laid on this day, i.e., 12 February'.

As the laying in one day of two *normal* eggs—as evidenced by the fact of both hatching later—is contrary to experience and to the condition usually prevailing in a state of nature, I suggested to Mr. Nayar that he may perhaps have overlooked the presence of the first egg in the nest on 11 February. Mr. Nayar in replying says: 'About the other point you have raised, I think I have possibly made a mistake. There was probably one egg in the nest on the 11th evening which I failed to feel. The next day I am sure there were two eggs because not only did I feel them but I

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also saw them by craning over the mouth of the nest to enable me to peep into it.'

The interval between the laying of eggs in almost all Passerine birds is the same as in the domestic hen, viz., 20 to 24 hours. Laying may at times be voluntarily retarded owing to adverse environmental causes, but only in very exceptional cases is the interval shortened and then it is usually due to some pathological condition, the eggs thus laid being malformed and unproductive. In the case of *Leptocoma asiatica* and *L. zeylonica* I have repeatedly found the interval between the laying of the first and second egg to conform to the usual rule in this Order, being something in the neighbourhood of 22 to 24 hours.

An extraordinary occurrence as described in the note requires careful verification before it is accepted as a fact. In the absence of such evidence it must remain a doubtful if not inaccurate record.

DEHRA DUN, U.P. SALIM A. ALI.
January 22, 1935.

XVII.—A DHAMAN (*PTYAS MUCOSUS*) 'RATTLING' ITS TAIL.

The other day I was walking along a dusty Gujerat road when a rustle in a *Euphorbia* hedge drew my attention to a bull-frog in the grip of a large dhaman. Picking up a piece of dry earth, I flicked it at the snake. It raised its head a few inches off the ground and rapidly struck its tail against some dry leaves, producing a steady rapping noise distinctly audible at a couple of yards. On further irritation, the snake glided off carrying the frog some 9 inches off the ground.

The American rattle-snake is well-known to have a similar but greatly specialised method of warning. Is this habit common among snakes? I would be grateful for any information that you may be able to give me on the matter.

GODREJ HOUSE,
ANDHERI. HUMAYUN ABDULALI.
October 4, 1934.

[A rapid muscular movement of the end of the tail is a reaction observed in many snakes when under stress of excitement. It is developed in a marked degree in the rattlesnake and in this species has resulted in the evolution of the peculiar rattle apparatus. Most vipers display this habit. The Green Pit-Viper (*Lachesis gramineus*) rapidly vibrates the tip of its tail when about to strike at its prey. It is a uniformly green snake; in some individuals the tip of the tail is red. The theory is that the red end of the tail sharply differentiated from the rest of the body by its colour, takes the semblance and movements of a worm and so draws the attention of birds etc. on which the snake preys. This is the theory. There are many such theories and how far they

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are correct we do not know. The habit is common also in many Colubrine species and in Boas and Pythons.—EDS.]

XVIII.—A CLEAR-WINGED MOTH (*PARANTHRENE* SP.) MIMICKING A SCOLIID WASP (*SCOLIA AURIPENNIS* LEPEL).

While botanising at Andheri (Salsette Island) during the month of August this year (1934), I noticed some Scoliid wasps collecting the pollen from the flowers of the *Leea* then in bloom (*Leea crispa* L. and *L. sambucina* Willd.). Numbers of these wasps were collected on almost every inflorescence. On one inflorescence among the wasps there was one which to all intents and purposes looked like a Scoliid wasp, but with an inexplicable *something* about it which attracted my attention and singled itself out from the others. Its colour, size, shape and its behaviour as it moved over the flowers among the wasps, were Scoliid, but yet that *something* distinguished it from its fellows. I watched it for a time but could not fathom the mystery. I caught it in a glass tube and on close examination, to my astonishment discovered that the 'wasp' was really a moth! It was an exact replica of the Scoliids. Mimicry is a well-known phenomenon in the insect world, but what particular advantage did this moth derive from such mimicry and association? Protection from its would be enemies! There is much room for speculation, but the answer will be only found by unveiling the life-history of these two insects.

On further investigation I discovered that the appearance of the wasp was linked with the flowering period of the *Leea*. A few wasps appeared during the early period when the *Leeas* were in flower, but they 'disappeared' when the flowering season terminated. Where do the wasps go? The answer is awaited.

The specimen of the moth was submitted to the Entomological Department of the British Museum (Natural History) for identification. Mr. Arrow in replying wrote:—'I am returning the Clear-Winged Moth sent to me for identification. It has been examined by Mr. Stringer who finds it to be a species of *Paranthrene*, unknown to us, but near *celebica* de Cerf. The Family is *Aegeriidae*. It is very interesting to know that the specimen was found in company with the Scoliid which it resembles.'

Four interesting points arise from this small observation:—

(1) The fertilisation of the two species of *Leea* by the wasp *Scolia auripennis*.

(2) The mimicry of *S. auripennis* by *Paranthrene* sp.

(3) The possible existence of a new species of *Paranthrene*.

(4) The periodical 'appearance' and 'disappearance' of the wasps, their movements being apparently controlled by the flowering of *Leea*.

BOMBAY NAT. HIST. SOCIETY,
BOMBAY.
December 5, 1934.

C. MCCANN,
Assistant Curator.

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XIX.—A NEW SPIDER OF BENGAL, MIMICKING *OECOPHYLLA SMARAGDINA* (FABR.).

(*With three text-figures*).

So far as I am aware, two species of spiders have been recorded by different authors, as mimics of the red-ant (*Oecophylla smaragdina*);[1] one of them, *Myrmarchne plataleoides* of the family *Salticidae* or *Attidae*[2] is a perfect mimic while the other, *Amyciaea forticeps*, Camb. of the family *Thomisidae*[3] is not so prominent.

In 1931, while collecting spiders from Lonsing, a village in East Bengal, I came across a peculiar female spider with its small pea-like faint brownish cocoon hanging from some tiny irregular silk-lines upon a middle-sized plant (*Nyctanthes arbor tristis* Linn.). The red-ants were in abundance upon the plant, though the spider itself was not found in company with them. She was very busy with her cocoon on a secluded branch of the plant. From external structure, the spider seems to be of the genus *Propostira*, Simon, of the *Theridiidae* family and is described below under the name *Propostira ranii*, sp. nov.

The spider showed a peculiar resemblance to *Amyciaea forticeps* Camb. in colour and in some other respects; but there are some striking differences in the formation of the body and its appendages. This seems to exhibit 'protective mimicry' or 'beneficial likeness' to *Oecophylla smaragdina* (Fabr.). The general appearance, colour and movements of the spider are so very ant-like that it can pass unnoticed in the midst of the ants, though the ant and the spider are not much alike when examined minutely.

About the protective mimicry of Line-weaving or Orb-weaving ant-like spiders Dr. McCook says:—'Whether or not any ant-like species are found among sedentary tribes I do not know. But it entirely passes my imagination to conceive what possible advantage could accrue to an Orb-weaver, for example from resemblance to an ant. Orb-weavers, and yet more frequently Line-weavers prey upon ants; but it is not necessary that there should be any resemblance to the emmet in order to accomplish the destruction of vast numbers of them, as I can fully testify. As the Orb-weavers and Line-weavers do not leave their snares to capture prey and move among the ants after the fashion of the

---

[1] (a) Hingston, Major R. W. G., I.M.S., F.Z.S., 'Field Observations on Spider Mimics', *Proc. Zool. Soc. Lond.*, ii, p. 844 (1927).
(b) Simon, E., *Hist. Nat. Des Araignées*, Paris, T., ii, p. 502 (1897-1901).

[2] Simon, E., *Hist. Nat. Des Araignées*, Paris, T. ii, pp. 496-505 (1897-1901).

[3] (a) *Ibid.*, Tome premier, p. 986 (1892-1895).
(b) Hingston, R. W. G., *Proc. Zool. Soc. Lond.*, ii, pp. 844-848 (1927).
(c) Kunhikannan, K., 'An Aggressive Mimic of the Red Tree Ant', *Jour., Bom. Nat. Hist. Soc.*, vol. xxiv, pp. 373-374 (1915).
(d) Mukerji, D. D., 'Report on a Collection of Ants (*Tr. oecophyllini* Forel)', *Jour., Bom. Nat. Hist. Soc.*, vol. xxxiv, pp. 157-158 (1930).

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prowling Saltigrades that do mimic ant forms, the fact of ant resemblance, should it exist among them, must have a quite different solution. One could suggest in their case, a protective value in resemblance to wasps, but none at all as against ants.'[1]

The mimicry of this spider to *Oecophylla smaragdina* may not be a case of protective mimicry against the ants, but it seems that this likeness helps to protect them from their natural enemies, viz., spider-eating lizards and birds, etc., as these are always found to keep at a safe distance from the biting red-ants.

Propostira ranii sp. nov.

The length of the female spider is 3.5 mm. Its cephalothorax is somewhat flat and oval-shaped, being longer rather than broad (Fig 1). The thoracic region is somewhat raised and triangular towards the back. The pedicle is very short and slender. The abdomen is truncated at the posterior extremity and much broader than the cephalo-thoracic region. The dorsum appears to be flattened or slightly concave. Down the abdomen, there are two protuberances or hump-like projections, one on each side, presenting a dorso-lateral aspect, with prominent broad black spot at the base of each of them. Further down, at the edge of the posterior extremity there are two more similar protuberances with similar black spots at their bases. Near the apex, the abdomen is rugose with some transverse black linings extending towards the ventral portion. The body is pubescent and brick-red all over with some blackish shades on the cephalo-thoracic region.

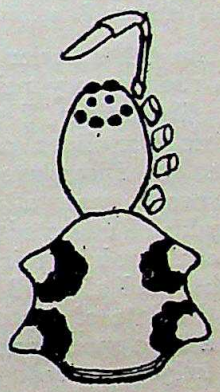

Fig. 1.—Dorsal view of *P. ranii* with 4 humps and prominent black spots.

The eyes, which are eight in number, are arranged in three rows. The anterior row contains the biggest pair of eyes which are projecting forward. The posterior row is procurved and contains four middle-sized eyes. The median row contains the smallest pair of eyes.

Legs are extended more or less in normal fore and aft directions. They are slender and pubescent, the front pair of which is the longest and strongest of all, measuring about 12 mm. The third pair of legs is the shortest while the second and fourth pairs are subequal. All the legs are bright brick-red in colour except the middle tibial and metatarsal portions of the front pair which are pale brown. Tarsal claws are black and two in number without any terminal tenent hairs.

Tibiae and tarsi of the pedipalpi are somewhat swollen in comparison with the rest of the joints. There is one black tarsal claw on each of the pedipalp.

Mandibles are unicate and pluridentate and covered with sparsely distributed black hairs. Maxillae are broad and long

[1] McCook, H. G., *American Spiders and their Spinning Works*, vol. ii, pp. 364-365 (1890).

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exceeding the mandibles and thinly covered with black hairs. They are strongly divergent with the semi-circular labium in between them. The sternum is slightly convex and more or less triangular in shape (Fig. 2).

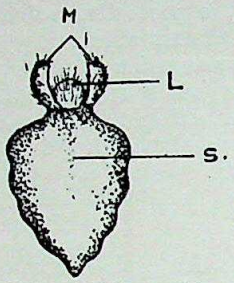

Fig. 2.—M. maxillae, L. labium, S. sternum.

Ventrally, there are some semi-circular folds with black linings on them, around the posterior margin of the abdomen (Fig. 3). The epigynum is very simple, occupying a small space between the pulmonary sacs, with a crescent cup-like atriolum which is swelled in the back. Six spinnerets are seen ventrally and behind them the anal papilla is conspicuous. The anterior pair of spinnerets are broad, sub-cylindrical and thickly covered with short black hairs. The posterior pair is less broad than the anterior pair. In the middle of these two pairs there is a rudimentary pair of spinnerets.

The spider, I collected, spun some irregular lines of thread, covering a small space, to which a pea-like cocoon was attached. The cocoon which I collected along with the spider contained 51 minute eggs which were hatched after 13 days, counting from the date of capture. I have with me a type specimen which has been carefully preserved.

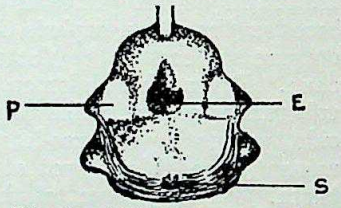

Fig. 3.—Abdomen ventral view. E. epigynum, P. pulmonary sac, S. spinnerets.

Bose Research Institute,
Calcutta.
March 1934.

GOPAL CHANDRA BHATTACHARYA.

XX.—ON THE MATING HABITS OF SPIDERS.

A study of the courtship among Spiders reveals evidence in favour of Darwin's theory of sexual selection. Engaged in collecting spiders, my one hour's attempt among the bushes was rewarded with five spiders. I secured them alive in separate tubes. They all appeared to be of the same species included in the genus *Peucetia*. One of them was a female and the remaining four males. I performed the following experiment:—

I took a conveniently big glass jar and introduced a circular piece of blotting paper into it to cover the bottom. I put the female specimen and one of the males into the jar and closed its mouth. Above the white background, their actions were clearly visible. At first the male remained still. After five minutes he seemed to exhibit some amorous movements of the limbs, but the menacing attitude of the female drove him away to the side of the jar. She did not wait any more but ferociously pounced on him; a contest ensued in which she gained the victory by killing her suitor.

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I put another male into the jar. The course and the result were the same as in the previous case, but the battle was longer.

I tried with the third one. He was an active fellow and as soon as he appeared on the stage he stood on his two pairs of hinder legs, lowered his abdomen, elevated his cephalothorax and greeted the female, raising his sexual appendages, front legs and all. She watched him carefully. Remaining in the same posture he glided towards this side and that, always shaking his palpal organs. Then he slowly advanced towards and began to run round and round her, she always turning about to face him. About fifty times he thus encircled her and taking advantage of one of her careless moments, smartly jumped on her and, sat comfortably on her cephalothorax facing her abdomen. He with his front legs embraced her. She did not object to this. The pair remained so for more than an hour but as I had to attend to office work I left them there and wrote these lines.

Why did the female not accept the first two suitors? Why did she allow the third one to mate with her? The only answer is the latter appealed most to her eyes perhaps he danced cleverly. But for his dancing he might have also become her prey. There is a selection of mates in this species and this selection is based apparently on the degree of attractiveness and power of dancing on the part of the males.

MAHIM P.O.,

BOMBAY. T. V. SUBRAHMANAYAM.

August 18, 1934.

XXI.—DO YOUNG SCORPIONS EAT THEIR PARENT?

There is a common belief regarding scorpions in Gujarat that the young scorpions, soon after being born feed upon the mother —the latter voluntarily succumbing to the injury. Is this not too much to expect of a mother of the class of *Arachnida* to wilfully perform such an act of self-immolation simply for furnishing food to her progeny?

The belief is, however, very common and reference to this is found in Gujarati poetry, bestowing praise on the scorpion female for her supremely self-sacrificing behaviour. In this connection it would be very interesting to know from any of the readers of your *Journal*, observations regarding the breeding habits of scorpions, if possible, about a series of generations and particularly about the Indian species.

BURMA FOREST SCHOOL,

PYINMANA. M. H. DESAI, B.AG. (Entomology).

August 28, 1934.

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XXII.—OBSERVATIONS ON TERATOLOGICAL INDIVIDUALS OF *APTINOTHRIPS RUFUS*[1] GMELIN.

(With two plates).

There are two forms of *Aptinothrips rufus*, the commoner with six-jointed antennae, and the scarcer with eight joints. Priesner[2] found a single case with seven-jointed antennae which he has described as *forma intermedia*.[3] This is important in view of its inter-relationship with the two forms of the species found in Europe and America.

The types of abnormalities in the antennae are classified here under five divisions:—

1. Reduction in the number of joints.
2. Malformation of individual joints.
3. Presence of single median antenna.
4. Fusion of two joints.
5. Presence of normal six- and eight-jointed antenna in the same individual.

1. *Reduction in the number of joints.*—This type of deformity is very common (Pl. I, figs. 1-3 and Pl. II, figs. 5, 6, 9) and the reduction is found in one or both antennae. In Plate I, fig. 1, the left antenna is five-jointed and the right six-jointed and normal. The measurements are:—Right:—*Length* (*Breadth*) 22 (25); 33 (25); 25 (18); 25 (18); 25 (22); 66 (18). Total 192 μ. Left:—22 (29); 29 (18); 18 (18); 22 (22); 55 (22). Total 137 μ. Right normal. Left shorter than the right, first joint normal, second smaller. Joints 1-3 pale yellow concolorous with those of the right side, fourth absent, sixth short and dark.

In Pl. I, fig. 2, right antenna is eight-jointed and normal, left seven-jointed and abnormal. Measurements are:—Right:—22 (29); 29 (25); 29 (18); 25 (18); 25 (18); 44 (18); 11 (7); 14 (3). Total 191 μ. Left:—22 (29); 29 (22); 22 (18); 22 (22); 33 (18); 22 (14); 14 (3). Total 155 μ. Fifth joint large and darker than the right. Sixth short. Seventh absent.

In Pl. I, fig. 3, right antenna is deformed and five-jointed, left normal and six-jointed. Measurements are:—Right:—25 (29); 29 (22); 22 (16); 22 (18); 59 (22). Total 151 μ. Left:—25 (29); 33 (25); 29 (18); 29 (18); 66 (18). Total 196 μ. Fourth absent, sixth shorter.

In Pl. II, fig. 5, left antenna is deformed and right is normal and six-jointed. Measurements are:—Right:—25 (29); 33 (25); 25 (18); 25 (18); 25 (18); 62 (18). Total 192 μ. Left:—25 (29); 29 (22); 18 (14); 29 (25); 18 (11). Total 107 μ. Third joint very

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[1] The material was collected at Edinburgh in 1930-1931. I am thankful to Dr. C. B. Williams, Chief Entomologist, Rothamsted Experimental Station, for the use of his collection and papers on thrips while at Rothamsted.

[2] Priesner, H. (1921), Die verschmelzung der Fühlerenglieder bei Aptinothrips rufus Hal (Ord. Thysanoptera) und ihre Ursachen. Kranchers Ent. Jahrb., pp. 162-166, fig. 1.

[3] Priesner, H. (1928), Die Thysanopteren Europas, i.iv, Wien.

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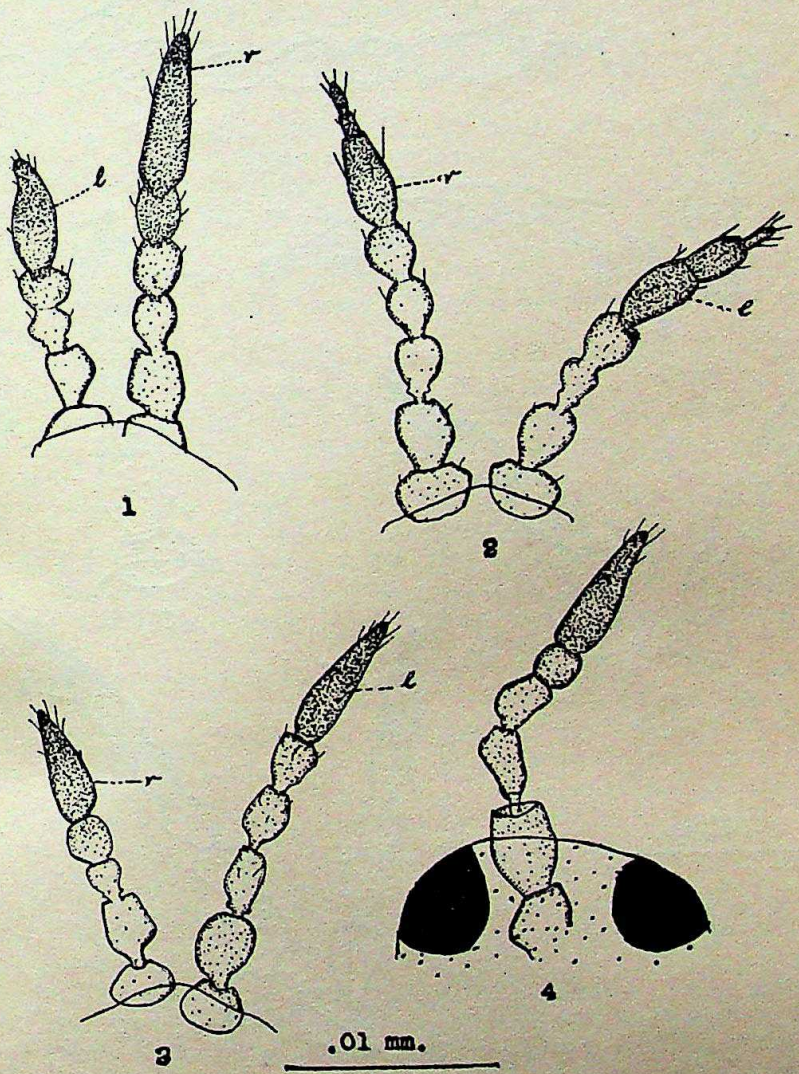

Antennae of *Aptinothrips rufus*.
Text figs. 1-4.
(*For explanation see body of note.*)

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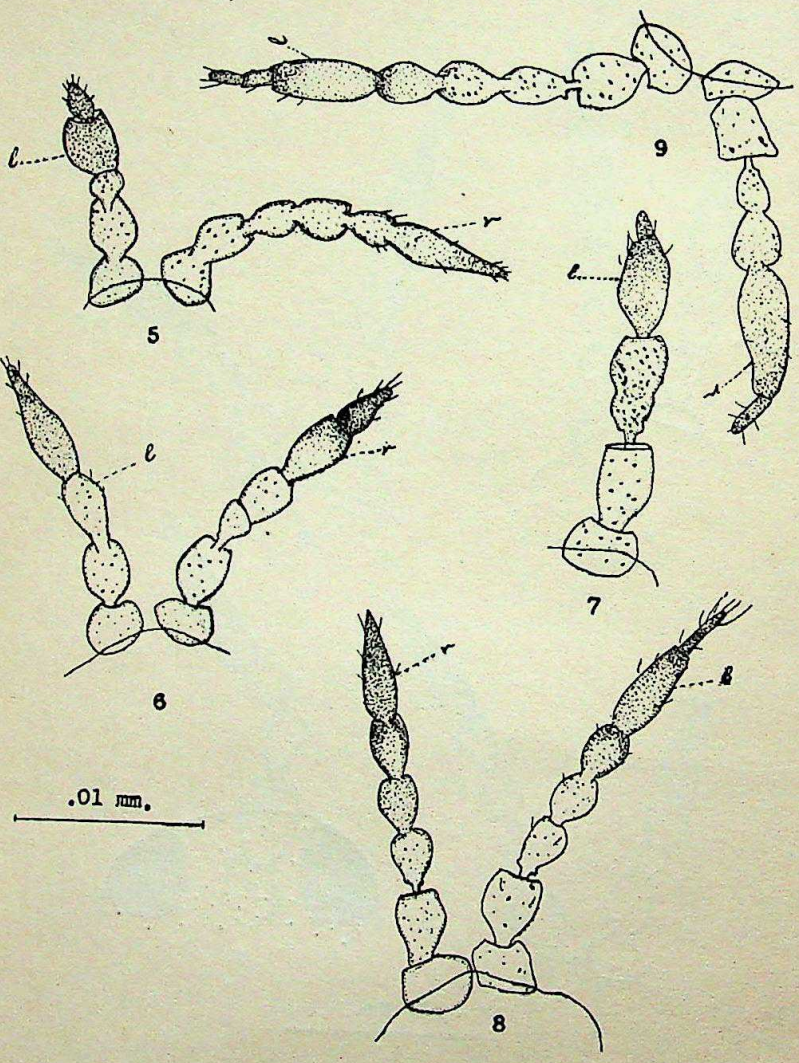

Antennae of *Aptinothrips rufus*.
Text figs. 5-9.
(For explanation see body of note.)

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small, fourth absent, fifth much swollen and dark, sixth very short and deeply pigmented.

In Pl. II, fig. 6, both antennae are deformed. Left has four and the right six abnormal joints. Measurements are:—Right:—25 (29); 33 (25); 22 (14); 25 (22); 33 (22); 25 (14). Total 159 μ. Left:—25 (29); 37 (22); 37 (22); 62 (18). Total 148 μ. Right antenna six-jointed, third joint short, fifth longer than the normal, sixth much smaller and deeply pigmented. Left four-jointed, third joint absent, fourth much longer, fifth absent, sixth long and appearing normal.

In Pl. II, fig. 9 right antenna is six-jointed and abnormal and the left is eight-jointed and normal. Measurements are:—Right:—22 (33); 29 (25); 22 (14); 25 (22); 59 (22); 22 (3). Total 174 μ. Left:—29 (29); 33 (25); 29 (18); 29 (22); 25 (18); 44 (18); 11 (7); 14 (3). Total 207 μ. First and second joints of the right shorter than the left, third shorter, fifth absent, sixth longer and wider than the normal. Seventh absent. Eighth longer and as wide as the left.

2. *Malformation of individual joints.*—It is seen in most cases (Pl. I, figs. 1, 3 and Pl. II, figs. 5, 7) that reduction or fusion is followed by malformation of joints. The joints are shorter or longer than the normal and some have grotesque appearances. The basal joints are invariably normal.

3. *Presence of a single median antenna.*—In this specimen (Pl. I, fig. 4) no trace of second antenna is visible. Measurements are:—18 (22); 37 (29); 33 (18); 22 (18); 18 (18); 59 (18). Total 188 μ. Basal boundary of the first joint not clear, second joint prominent and large, fourth curved, fifth rounded, sixth deeply pigmented.

4. *Fusion of two joints.*—Occasionally two joints are fused (Pl. II, fig. 7) to make a single joint. In some cases the line of demarcation between the joints is not visible.

5. *Presence of normal six- and eight-jointed antenna in the same individual.*—The presence of six- and eight-jointed antenna (Pl. II, fig. 8) in the same individual was found in a very large collection of eight-jointed forms. Measurements are:—Right:—25 (29); 29 (25); 29 (18); 25 (18); 25 (18); 44 (18); 11 (7); 14 (3). Total 196 μ. Left:—22 (29); 29 (25); 29 (18); 25 (18); 25 (18); 51 (18). Total 185 μ. The right antenna is eight-jointed and the left six-jointed.

Length, breadth and pigmentation of individual joints are almost like the normal ones on two separate forms. It seems very probable that this and the seven-jointed intermediate form (forma intermedia, Priesner) suggests the connection between the two forms of *Aptinothrips rufus* which are distinguished by antennal characters.

ZOOLOGY DEPARTMENT,
AGRICULTURAL COLLEGE,
CAWNPORE.
March 14, 1934.

U. S. SHARGA,
M.SC., PH.D., F.E.S.

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XXIII.—TERMITES AS FOOD.

I have perused the small note on 'Termite Collection in South India for Food' sent to you by Mr. T. V. Subramaniam of the Government Museum, Madras, published as note xxii on p. 498 of your last issue. I may inform the writer that the fact that white ants are edible is not at all new. I am afraid he has not read the previous literature on this subject which is as old as 1779 when the Danish naturalist Dr. Koenig published a very interesting account of white ants in South India. I would advise the writer to peruse a translation of Dr. Koenig's paper by Fletcher in the Report of the Fourth Entomological Meeting, Pusa, 1921 (pp. 301-333). In that paper the learned naturalist gives a very interesting account of termites and also explains how people in parts of Tanjore catch termites for food and Fletcher also gives photographs of the methods adopted in parts of Coimbatore. Catching of winged termites (*Easel*) for food is quite a common thing in all parts of South India.

AGRICULTURAL RESEARCH INSTITUTE,

COIMBATORE. T. V. RAMAKRISHNA AYYAR, B.A., PH.D.,

September 15, 1934. *Offg. Government Entomologist.*

XXIV.—STEM FASCIATION IN THE COCOANUT PALM (*COCOS NUCIFERA*, LINN.).

(*With a photo*).

Many instances of stem fasciation in dicotyledonous plants are on record (1, 2 and 3) while in monocotyledonous species, the phenomenon is apparently rare.

An interesting specimen of stem fasciation in the cocoanut was noted by the author in June 1932 in a garden near Erode, Coimbatore District (*Vide* photograph). The tree is about 20 years old and appears to have had quite a normal growth up to the time of fasciation. Above the normal trunk of about 25 ft., the stem flattened and seven growing points appeared and began to develop in one plane. The first leaves were plaited like those of coconut seedlings. These leaves, however, soon became normal pinnate ones with distinct leaflets. There are six healthy branches as seen in the photograph. The position of a dead branch is where a boy is seated.

The exact cause of the phenomenon is not known. The usual causes producing stem fasciation, viz., super-abundant nutrition and diseases do not seem to hold good in this instance. The gar-

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den was quite an ordinary one and no special treatment was given to the tree. There was no evidence of any disease.

Stem fasciation in the Coconut (*Cocos nucifera*, L.).

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2. W. C. Wordsell, ? , Vol. i, p. 111.
3. O. Penzig, *Pflanzen-teratology*, p. 439.

K. CHERIAN JACOB, L.Ag., F.L.S.

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Continued from page 111 of Vol. XXXVII, No. 1, of the Journal of the Bombay Natural History Society.

THE WILD ANIMALS OF THE INDIAN EMPIRE

AND THE

Problem of their Preservation

Part III.

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SNOW LEOPARDS.

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THE WILD ANIMALS OF THE INDIAN EMPIRE.

PART III.

CARNIVORA OR BEASTS OF PREY.

The Carnivora or flesh-eaters is a name given to a distinctive group of animals known familiarly as 'Beasts of Prey'. The assemblage includes the cats, great and small, and such varied animals as civets, dogs, bears and the weasels and their numerous kindred. It also includes the aquatic beasts of prey—seals, sea-lions and walruses.

Not all these animals are exclusively or even mainly flesh-eaters. Some live partly on vegetable food. Again, many mammals not classed as carnivores feed on flesh. The Australian Dasyures, creatures not much bigger than a cat with the predaceous habits of weasels are wholly carnivorous. But they, like the well-known kangaroo, are broadly distinguished as Marsupials or 'pouched' animals. With this exception it might be said that there is no group of mammals which feeds so generally on flesh.

The Carnivora as a whole reveal in their structure certain characters which are common to all of them and which mark them as animals whose particular role is the capture and destruction of living prey. The evidence of a predatory life is most signally revealed in the structure of their teeth and claws—essential weapons designed to secure for the beast of prey its appropriate food. Very striking in the skull of a carnivore are the canine teeth. The majority of mammals have canine teeth, but in carnivores the canines tend to become larger and stronger than the incisors and in some of the great cats these teeth are represented by enormous offensive fangs. Their special purpose is the seizing and holding of prey. All carnivores have 6 incisors. Usually, the outer incisor in the upper jaw is the largest and sometimes it is so large and pointed that it looks like a small canine. Canines and incisors provide the beast of prey with appropriate weapons for seizing, holding and biting. The mastication of food is the work of the cheek or molar teeth. Among carnivores there is much variation in form and structure of the molar teeth—variation which is related to some extent to the degree to which a particular animal is or is not wholly carnivorous.

Apart from the teeth, the most distinctive feature in the skull of a carnivore is the mode of articulation of the lower jaw. It is connected to the skull and moves on a small transverse hinge. The device gives strength to the joint but deprives the animal of the power of moving its jaws from side to side or backwards and forwards. Movement is limited to an up and down biting or snapping action, and the grip of the jaws is intensified by the great biting muscles which secure the lower jaw to the skull. Strong cheek arches and ridges have been developed in the skull to provide an attachment for these muscles.

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All the carnivores have never less than four toes on each foot and these are generally armed with strong sharp claws. The clavicle or collar bone is frequently absent in beasts of prey. This is a feature which they share with hoofed animals. When present, it never forms a complete connection between the breast bone and the shoulder blade. It is reduced to a splint of bone embedded in the muscles of the chest. The brain of a carnivore is well developed and the stomach is always simple.

These are some of the characters which distinguish carnivores from other mammals.

In themselves they form a varied assemblage in which two great divisions are recognised. One includes the terrestrial and the other the aquatic Beasts of Prey.

Seals, walruses and sea-lions form the latter group. Descendants of land-dwelling carnivores, as a result of subsequent development into animals whose element is the water, they have undergone many changes in form and structure and have lost some of the main features which distinguish their terrestrial relatives. The name *Pinnipedia* or 'fin-footed', by which this sub-division of the Carnivores is known, describes the condition of their hands and feet which have been modified into flippers. Mainly inhabitants of cold seas, none of these animals is found in India.

The terrestrial Beasts of Prey are called *Fissipedia* or 'free-footed', in allusion to their distinct and separate toes which are never encased in skin to form a fin or flipper.

As organs of locomotion the limbs are not swimming but essentially walking, running or climbing organs. Walking is effected either on the entire sole of the foot as in the bears or, as in cats and dogs, mainly upon the toes with the hinder part of the foot held clear from the ground. A somewhat intermediate mode of walking is found among weasels, otters and badgers. Most carnivores are good climbers. Some live almost entirely in trees.

Terrestrial beasts of prey display a varied and highly developed armament of teeth. While the canine and incisor teeth of various species are on the whole tolerably uniform, the molar or cheek teeth display numerous and interesting variations. A reduction in the number of cheek teeth and the compression of their crowns into narrow cutting edges generally indicate an exclusive diet of flesh. While the more numerous the cheek teeth and the broader their crowns, the more likely it is that the owner subsists on a mixed diet. Extremes of these two types are seen in the cats and the bears—one wholly carnivorous the other mainly herbivorous; while stages between the two may be traced through other forms of Carnivora. A striking peculiarity in the molar teeth of beasts of prey is the development of a carnassial or 'flesh-tooth'. In the majority of families it is larger than the other cheek teeth. The flesh tooth in the upper jaw is always the last premolar—its antagonist in the lower jaw is the first true molar. The crown of the upper flesh tooth consists of two parts, a sharp edged blade divided by notches into two or more cusps borne upon two inner roots and the 'tubercle' a short blunt cusp supported by a separate root. In carnivores which are purely flesh feeders—the flesh

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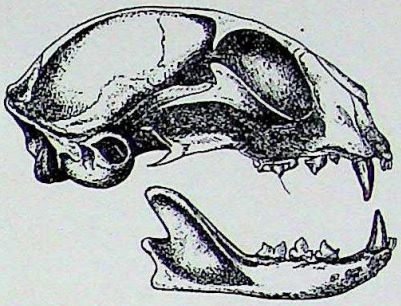
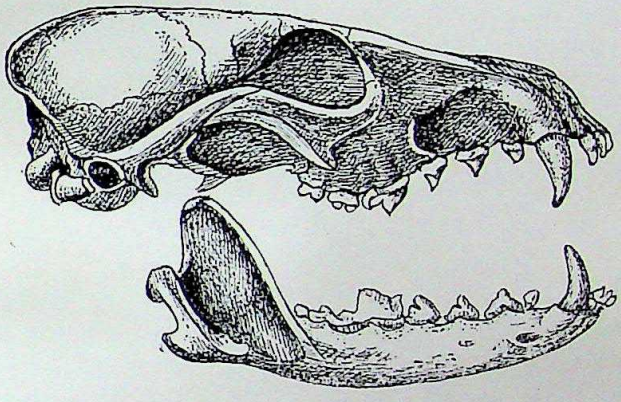
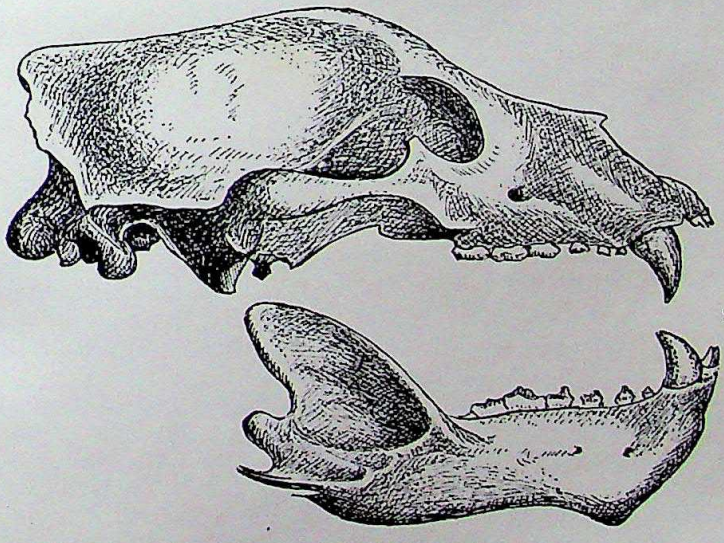


Domestic Cat.



Common Fox.



Sloth Bear.

SKULLS OF CARNIVORES.

To show variation in the number and form of cheek teeth

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tooth is conspicuous—its blade well developed and its 'tubercle' reduced in size. An increase in the tubercular character of the tooth is usually traceable through those genera which are mixed feeders. In bears, the flesh tooth is scarcely distinguishable from the other cheek teeth. The lower flesh tooth varies in form. In cats, its crown consists solely of a blade which is divided into two large pointed cusps. Behind these cusps there is a small rudimentary third division. The opposing blades of the upper and lower flesh teeth work against one another with a scissor-like action. They provide the mechanism for shearing flesh from bones or crushing hard food. Generally the molars in front of the flesh tooth are sharp pointed and compressed, those behind are broad and tuberculated.

With the exception of Australia and New Zealand, the Carnivora inhabit all the countries and larger islands of the Globe from the icy oceans of the Arctic Circle to the tropical plains of India and Africa. Some, like cats and dogs, have a world-wide distribution; others, like the hyaenas and civets, are restricted in their range. In the earliest part of the Tertiary epoch there were numerous Carnivores small and large. Their skulls were much like those of existing Carnivora. They had cutting teeth and clawed feet. The brain was small. They are now grouped in a distinct sub-order—the *Creodonta*. Some of them were the ancestors of modern Carnivores. Others have left no descendants. In habit and general appearance these primitive carnivores were like the modern beasts of prey—but the various distinctive features of the modern races are found in these ancient forms in different combinations.

Various carnivores related to the modern forms lived during the latter part of the Tertiary period. Perhaps the largest of them were the Amphicyons. Classed among the dogs, the amphicyon equalled the biggest bear in size and revealed in its structure some affinity to these animals. A survivor of this archaic animal lived in the Siwaliks. These mountains were also the home of two species of sabre-toothed tigers (*Machærodus*) representatives of a family of extinct cats. The sabre-toothed tiger had enormous upper canines. They took the form of great slightly curved compressed fangs with serrated edges. The jaws were loose hung and could be opened wide enough to allow full play for the action of the tusks and so allow the powerful muscles at the back of the neck to drive them down vigorously into the body of an enemy.

The modern land Carnivora are divided into three sections, the distinctive characters between them being derived mainly from difference in the structure of the base of the skull. These sections are: (1) the *Aeluroidea* or Cat Section; (2) *Cynoidea* or Dog Section; and (3) the *Arctoidea* or Bear Section. Each of these three animals the cat, the dog and the bear provides the pattern of its group.

The Cat group or *Æluroidea* includes the cats, civets, mongooses and hyaenas. The Dog group, *Cynoidea*: dogs, jackals, wolves and foxes. The Bear group, *Arctoidea*: bears, badgers, racoons, martins and weasels.

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ÆLUROIDEA: Cat Section.

Family I. *FELIDAE*: CATS.

The Cats, great and small, though they vary much in size and habits, form a well-marked tribe with characters which distinguish them from all other Carnivores. Splendidly equipped for their role in life, they represent the Beast of Prey in its perfection. The Cats are supreme in armament of tooth and claw, in their combination of grace, strength and agility.

None of the Beasts of Prey display so powerful a development of teeth as some of the great cats and in none are the teeth so perfectly adapted to a purely carnivorous diet. Increased sturdiness and strength has been attained in their jaw bones by a reduction in their length. The comparative shortness of the jaws in relation to the length of the head gives the Cats that flatness of feature which contrasts so markedly with the pointed muzzles of civets or the long snouts of dogs and bears.

With the shortening of the jaw bones there has been a corresponding loss in the number of cheek teeth. Cats have much fewer cheek teeth than dogs or other more generalised forms of carnivores. Speaking generally, an exclusive diet of flesh is indicated by a level row of small pincer-like incisors, by large, deeply implanted and widely separated canines and lastly by a reduction in the number of molar teeth—the normally broad grinding crowns of those that remain being compressed into sharp-edged cutting implements.

This is a condition seen in its most perfect form in the teeth of cats. A modification in the number and shape of their teeth has been effected in early stages of their evolution by those processes which adapt the structure of a creature to its specific needs. A study of the teeth of primitive and now extinct forms of cats shows that the perfecting of their dental armament has been arrived at by stages. Firstly there was a reduction in the number of cheek teeth, followed by an enlargement of the canines which took their conical form and finally came the modification of the cheek teeth into purely cutting instruments.

In existing cats the first cheek tooth in the upper jaw is small or sometimes absent. The second cheek tooth shows a sudden increase in size. It is a large and sharply bladed tooth. The third tooth displays even greater gain in strength and size. Its crown is divided by two notches into 3 sharp pointed blades. This is the upper carnassial or 'flesh tooth'. It is the last premolar in the upper jaw. Tucked away behind this great tooth and set transversely to it is the solitary surviving molar. From its size and position it can be of little significance in mastication.

Of the three cheek teeth in the lower jaw the first two are premolars, and third and last tooth is a true molar. It is divided by a V-shaped notch into two blades. It functions as the lower 'flesh tooth'. The peculiar articulation of the lower jaw to the skull which is characteristic in beasts of prey prevents a circular grinding action and confines the play of the cheek teeth to a ver-

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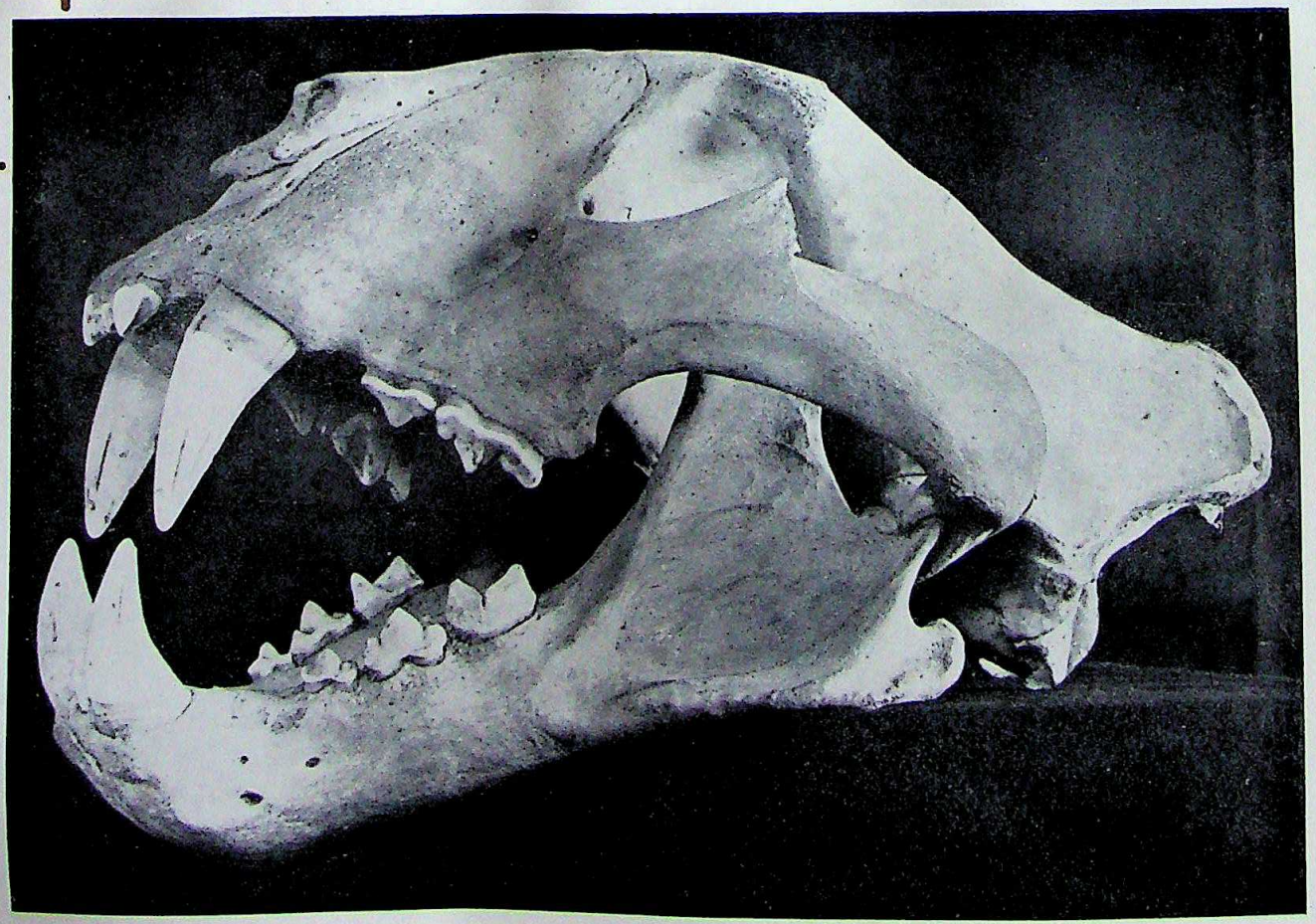

SKULL OF A TIGER.

Note the enormous widely separated canine teeth, the few blade-like cheek teeth, supported on short powerful jawbones and the sturdy cheek arches which help to provide attachment for the great biting muscles.

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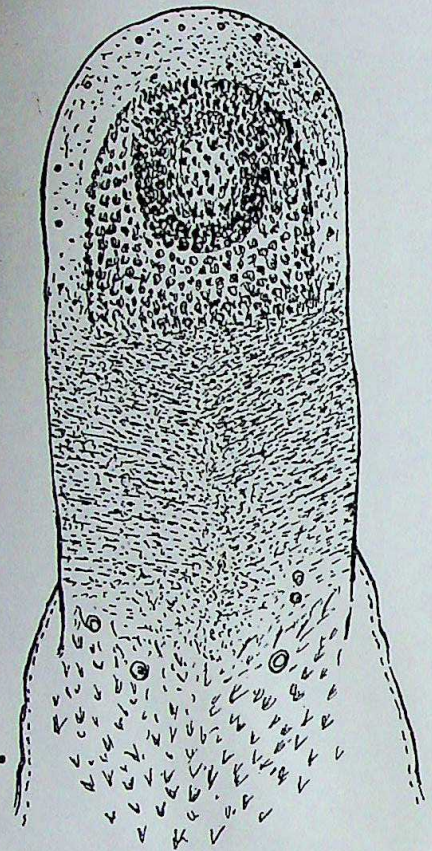
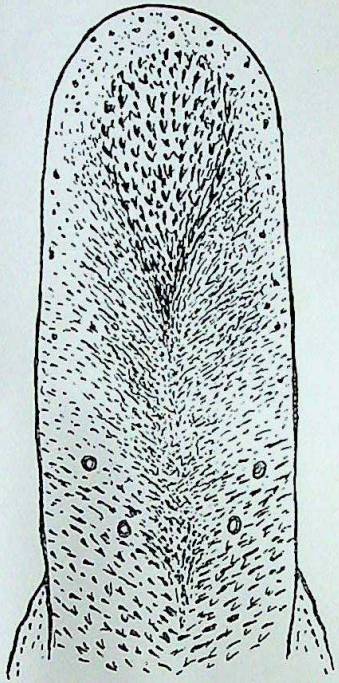
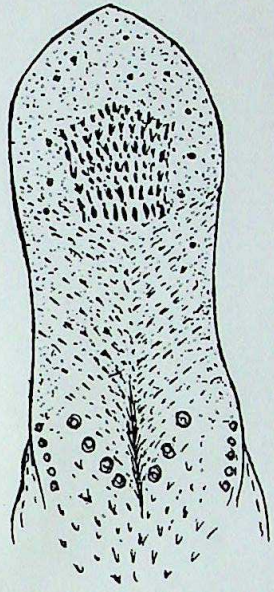
TONGUES OF "CATS".



TIGER (*Pantherinae*).



CHEETAH (*Acinonychinae*).



CARACAL (*Felinae*).

The sharp-pointed conical papillae tend to form a "spinous patch" on the fore part of the tongue. The proximity of this patch to the apex of the tongue, its posterior limits, the shape of the spines are distinctive on the 3 subfamilies in which the Cat tribe is divided. (Dr. C. F. Sontag, P.Z.S, 1923).

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tical up and down movement in which their compressed and sharp edged crowns working against one another cut and coarsely divide the flesh. The deep rooted trenchant and sharp pointed canine teeth are well adapted to hold, to pierce and lacerate struggling prey. We have referred to the reduction in size or complete suppression of the first cheek tooth. This leaves a space between the molars and canines. Thus, the great canines which interlock in the closed jaw stand clear when the jaws open and are driven full into the flesh of a victim. There are no contiguous teeth to obstruct their complete penetration.

There is a level row of 6 small pincer shaped incisors in the upper and lower jaw. Their purpose is to gnaw the soft gristly ends of bones and scrape off the tendinous attachments of the muscles. The array of sharp incisors, the powerful canines, the blade-like molars, have their special function and each is perfect for its special purpose. This armament of teeth supported on short powerful jaws controlled by great biting muscles, for whose attachment special provision has been made in the wide sturdy cheek arches and the bony crest of the skull, complete the Cat's formidable equipment for the killing and ingestion of its prey.

But carnivorous animals which tear to pieces and swallow their food can scarcely derive much enjoyment from its taste. It is only in Man and those herbivorous animals which prepare their food by mastication that the sense exhibits much delicacy of perception and the tongue attains a perfect adaptation to this end. In the Cats the mechanical function of the tongue predominates over the sensitive. Numerous papillae which cover the tongues of animals make them rough to the touch. In cats this roughness is greatest. These lingual papillae are of three types. In the Cats those which function as organs of taste are reduced to small dimensions. They are scattered about the surface of the tongue and are more abundant on its margins. Most numerous and prominent are the 'conical papillae'. In cats these conical papillae are encased in horny, pointed sheaths which stick into one's fingers like so many pins. Their function is purely mechanical. Their numerous sharp and rigid points give the tongue the action of a rasp. Bones are not usually crushed and swallowed by cats. They are licked clean and left and the rasp-like tongue is well adapted to remove the remnants of flesh which adhere to a bone. In the Cats the conical papillae tend to form a 'spiny patch' on the fore-part of the tongue which is surrounded by a zone of smaller papillae. The proximity of or the distance of this spinous patch from the apex of the tongue, its extent, the shape of the spines which form the cluster, are distinctive in certain groups of cats. A study of the lingual-papillae in the Felidae, their character and arrangement has offered a means of throwing fresh light on the relationship of the different species.

Like the teeth, the strongly curved claws of cats reveal a perfection of development unequalled by other carnivores.

A beautiful and peculiar provision is seen in the structure of the foot whereby the claws are kept constantly sharp and are never worn down by contact with the ground. The terminal or

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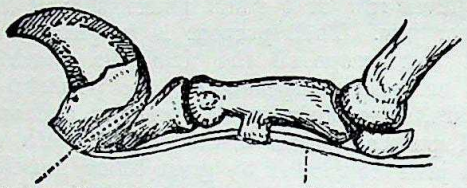
claw bearing joint is so articulated that in its normal position it lies folded back on or against the preceding joint. In this reverted, partly erect position the claw at its summit is raised off the ground. An elastic ligament holds the joint erect and the claw is received into a sheath of skin specially devised for its reception. When the animal springs upon or strikes at its prey, a tendon clamped to the undersurface of the terminal joint and connected to the great flexor muscles of the limb pulls upon this joint and draws it from its reverted position downwards and forwards. The claws emerge from their sheaths and are bared for action.



Bones and tendons of toe of the Cat. A, claw retracted and held erect by retractor ligament. B, claw extended, pulled downwards and forwards by extensor tendon.

How far the sheaths protect the claws depends upon two factors, the extent to which the claw-bearing joint can be drawn backwards and the length of the sheaths themselves. The Cheetah or Hunting Leopard is often described as having imperfectly retractile claws. A cheetah has the mechanism for retracting its claws and can draw them back as well as some species of cats, but the constantly bared condition of its claws is due to the rudimentary condition of the claw sheaths. These claw sheaths are by no means equally developed in all the Cats. In their most elaborate form as seen in the Lynx, the Tiger or the Leopard, the pollex or thumb is enveloped in a hood-like sheath and the lobes of the sheaths protecting the other claws are large enough to completely enfold them. In some of the smaller cats on the other hand the lobes of the sheath are not equally developed on all the digits and some of the claws are not completely covered—a condition not far removed from that of the civets. Between these two extremes every gradation in the development of the claw sheaths may be seen in cats.

Let us now consider movement in cats and their faculties of sight, scent and hearing—means by which they hunt their prey.

All cats are digitigrade. They walk on their toes and not upon the palms or soles of their feet. When walking the hinder

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part of the foot is entirely raised from the ground the weight of the body is taken by the toes—but not by the tips of the toes as in hoofed animals. This mode of progression is an improvement on the flat-footed gait of bears or of those carnivores which walk partly on their toes and partly on the soles of their feet. It makes for greater agility of movement.

A cat has five toes on its fore-foot and four on its hind. The innermost toe of the fore-foot, the pollex, corresponds to the thumb of the human hand. It is placed at a much higher level than the other toes and is of little use when walking. The missing toe in the hind-foot corresponds to the great toe of the human foot.

Soft pads under the toes and a broad cushion-like pad under the ends of the bones on which the foot rests when walking help the cat's stealthy movements. Its sinuous supple body, its muffled tread, its gliding progress, brought about by a simultaneous movement of the limbs on each side—concur in effecting a noiseless approach to its prey.

Cats have the largest eyes of all the carnivores. A well developed system of muscles within the eye contracts the pupils in bright light and protects the eyes from glare and by dilating them in darkness allows as much light as possible to enter the eye and so improves its vision. The form taken by the contracting pupil differs markedly in the great and small cats. In domestic cats and in the smaller species generally, the pupil contracts to a narrow slit with two pinholes at each end through which alone the light enters. In the larger felines the contracting pupil takes a circular form.

It is generally agreed that when hunting the sense of smell is the dominant factor in dogs, in cats it is the sense of vision. It is suggested that the flat muzzle characteristic of cats leaves less space for the development of the nasal membranes which have greater scope for development in the longer muzzles of dogs, wolves and foxes. The relative development of the faculties of sight and scent appears to differ in various species of cats. The consensus of opinion is that the Tiger and the Panther display great acuteness of vision and, unlike the Lion, a corresponding dullness in their sense of smell. It is frequently held that these two animals depend mainly on sight and hearing when hunting. But it is difficult to conceive that animals which hunt under cover of darkness do not make the fullest use of both the faculties of sight and scent when seeking their prey, particularly in forest where vision may be circumscribed. At present we have only the vaguest knowledge as to how far purely nocturnal animals depend on vision for obtaining their food. This is one of the reasons why it is so difficult to arrive at any definite conclusion as to the real value of 'concealing' colours in nocturnal animals.

It is believed that a pattern of spots and stripes—so common in the colouration of the cats—is protective. The variegation of tone breaks up the mass of the body, obscures its contours and so helps to conceal it. This is a common explanation of the purpose of markings in tigers, leopards and other beasts of prey. But a patterned hide, if useful to the hunter, would be equally useful to

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its quarry. Many species of deer which are the accustomed prey of great cats are uniformly coloured when adult, whereas a concealing pattern on their coats would have proved a useful factor in evading detection. Now, if a spotted condition of the young is taken to indicate the primitive colouring of the parents, then the majority of deer are descendants of striped or banded ancestors and pattern in these animals has since been discarded—at least in the colouring of the adults of most species. This suggests that in these animals its significance as a factor in the struggle for existence could have been of no great importance.

Again, the absence of stripes and spots in the lion and other carnivores places them at no disadvantage in securing their prey. Like the tiger, the lion hunts in shadowy forest, in open bush or in grassland and it is claimed that in the African reed beds—a favourite hunting ground of lions—a vertically striped coat would have provided an ideal concealing pattern.

While a variegated colouration may prove a factor in the protection of lesser and more sedentary creatures; it cannot be regarded as essential to the equipment of a beast of prey. Cats, great and small, owe their ascendancy to their perfect mastery over the craft of hunting. Strong and active, of high intelligence, they display a perfection of senses and bodily organism which gives them mastery over creatures in which a ceaseless struggle for existence has perfected the means of escape.

As with all animals the ground colour of the cats varies with environment. There is the change from the light drab tones of desert species to the rich dark colouration of those living in more humid forests. The law of assimilation of colour to environment is more or less constant in Nature. Hazardous deductions of its purpose may lead us into beliefs which are at variance with evidence revealed by the actual lives and habits of animals.

The pattern of different species of cats is in general constant. Individual variations occur. Stripes sometimes break up into spots and spots show a tendency to run into stripes but as a general rule each species breeds true to its local type and there is little change in pattern except perhaps in its accentuation, lightening or obliteration with age. The lion and the puma are uniformly coloured when adult, though spotted or striped when cubs, which is taken as an indication of their descent from striped or spotted ancestors. There is a theory that there have been definite stages in the evolution of stripes and spots in the Felidae. The theory assumes that in the primitive condition, the stripes were longitudinal—a condition now common in the civets—next of kin to the cats. In the second stage the longitudinal stripes broke up into spots. Many civets and some cats again exhibit this pattern. It is perhaps also illustrated in the pattern of the Spotted Deer—the linear arrangement of the spots on its lower flanks suggests longitudinal stripes which have broken up into spots. In the third stage the spots reformed into vertical stripes such as one sees in the tiger, in the banded civet and in certain antelopes. The patternless hide of the adult lion or the puma is taken as the culminating phase in the evolution of markings. If this theory is

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correct then the progenitors of the tiger were longitudinally banded animals whose descendants passed through a spotted stage and finally attained the transverse stripes of existing tigers. The oblique direction of the stripes on the hind quarters and other parts of the tiger's body, the curious variations in their markings where spots crop up between stripes or stripes tend to continue as faint spots or to double up into loops or the rudiments of a 'rosette' are taken to lend support to this theory. Again the curious variations sometimes exhibited by lion cubs in which spots show a tendency to fuse into stripes, are also quoted as supporting evidence.

To sum up the distinctive characters of Cats as a tribe. There is the shortening of the muzzle—the reduction in the number of cheek teeth, the powerful development of the canines and flesh teeth, the strongly curved retractile claws. These are characters which mark them as a natural and distinctive group of animals. But it has been the contention of zoologists during the last half century that the comprehensive genus *Felis* in which all cats great and small were included required regrouping into several distinct genera. Various attempts to do this have been made by naturalists. The most recent is by Pocock. His purpose was to indicate more clearly the true relationship of different forms of cats and to dispose of such fictitious groupings as imply a close relationship between the Lion and the Puma or give an erroneous impression of the relative affinities of such creatures as the tiger, the domestic cat and the lynx. He based his classification on the variations which are apparent in the structure of the hyoid apparatus in different forms of cats, on differences in the form of the feet and the cutaneous sheaths guarding the claws. He divides the family Felidae into three well-marked groups:

(i) The *Pantherinae* which comprises the Lion, the Tiger, the Panther, the Jaguar and the Ounce.

(ii) The *Acinonychinae* the Cheetahs or Hunting-Leopards.

(iii) The *Felinae* which includes the Puma, the Lynx, and all the smaller cats.

As regards the scientific names of different species, many have received more than one name from naturalists and the tracing of the correct name from the tangle of zoological literature is a matter of no small difficulty. Here again we have followed the nomenclature adopted by Pocock in his recent papers on Felidae which include a careful revision of the synonymy of the various species with which they deal.

With the exception of the Australian continent and Madagascar—the range of cats is universal—the headquarters of the tribe is the Old World. Sixteen different species occur in India and its dependencies, a larger concentration than is to be found in any tract of similar size on the Earth's surface. Of the cats living within our borders during past geological epochs, more than 7 species are known, some similar to existing forms others now extinct. Among them was *Felis cristata* which was quite as large as the tiger and two extinct species of sabre-toothed tigers (*Machærodus*) one peculiar to India.

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Sub-family: I. *PANTHERINAE.*

The Lion, Tiger, Leopard, Jaguar and Ounce.

While most cats, particularly the larger species, are readily distinguished by their form, colour or size it is less simple to discover among them differences in anatomy which offer a clue to the true affinities which exist between the different members of the tribe—distinctions which would help us to discriminate between closely related forms and those which reveal a lesser degree of kinship. Perhaps the most striking variation in the internal anatomy of cats is to be found in the mode of attachment of the hyoid apparatus. It is perhaps an obscure detail in the structure of cats but the mode of attachment of the hyoid has an influence in some way on the voice of the animal—on the power and variety of tone it can produce. Now a similarity of voice is considered nearly always a good indication of affinity among animals. Resemblances or differences in the structure of the hyoid therefore provide evidence which is useful in the classification of the felines. In the lower Vertebrates, in fishes for example, the elaborate hyoid apparatus is importantly connected with the respiratory function, but in mammals it is reduced to a much simpler condition. The apparatus, usually composed of a number of small bones, is named *Hyoid* because of the arrangement these bones in the shape of an arch or of the Greek letter Y. In mammals the arms of the hyoid are suspended from the posterior part of the skull to provide a support for the root of the tongue and for the larynx i.e. the extended part of the wind pipe which contains the vocal chords. The apparatus comes away when the soft parts of the skull are removed. In the smaller cats arms of the hyoid are composed of an uninterrupted chain of small bones which hold the larynx close to the skull and so restrict its power of movement. In the great cats —in the lion, tiger, panther, jaguar and ounce—the arms of the hyoid are imperfectly ossified. In the lower part the small bones are replaced by elastic ligaments. In the lion these tendons may be 6 in. long and may stretch to 9 in. The elasticity given to the hyoid by these tendons allows greater mobility to the larynx. It is not drawn up close to the skull but is embedded in the mobile muscles of the throat. The difference in the mode of attachment of the hyoid seen in the great and smaller cats has resulted in those differences in voice which is so noticeable among them.

The lion, tiger, leopard and jaguar are able to roar but are incapable of purring; while the cheetah, the puma and the smaller cats, whose hyoid is differently constructed, do not roar but can express contentment by purring. Though the roars of the great felines are more or less distinguishable there is an underlying distinctiveness in the power and variety of sounds they produce which is due to the distinctive structure of the hyoid. It differentiates them from the other cats and offers an indication of their affinity to one another. Evidence of relationship between the great felines is also traced in a similarity of pattern in the cubs which may be

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taken as a specific character. The lion shows a pattern intermediate between the tiger and the leopard and the leopard in its markings shows a definite affinity to the jaguar. The ounce because of similarity in the structure of the hyoid is likewise included in this group of cats. The affinity between these animals is also indicated in a similarity in the position, extent and nature of the conical papillae which form the 'spinous' patch on the surface of the tongue, to which reference has already been made. In the great cats the patch commences near the apex but does not extend to the middle of the tongue. It is a condition which does not occur in the tongues of other cats and provides further evidence of structural kinship between these great felines.

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THE ASIATIC LION (*PANTHERA LEO PERSICA* MEYER).

The racial name *persica* is given to lions found in India, Persia or Mesopotamia. One species of lion inhabits both Africa and Asia, but minor differences, more or less constant, are considered sufficient to indicate a racial distinction between Asiatic and African lions. These distinctions do not always hold when individuals from the two countries are compared. They can only be regarded as average differences.

On the average, the Indian lion has a scantier mane than the African and, curiously enough, in combination with this character a fuller coat, a longer tassel of hair at the end of the tail, a more pronounced tuft of hair on the elbow joints and a fuller fringe of hairs on the belly. In size, there is little to choose between the two. The average length of African and Asiatic lions is a few inches over 9 ft. The largest recorded measurement of an Indian lion is 9 ft. 7 in., of an African lion 10 ft. 7 in.

The colour of the lion is tawny. The density of the tone varies in different individuals. Some lions are deep yellowish brown, others are pale, in others again the prevalent tone is sandy grey. Dark tips to the hairs may give the coat a finely mottled effect.

The cubs are spotted and striped. The pattern is taken to indicate descent from a progenitor with markings midway between the spots of a leopard and the stripes of a tiger. The markings fade with growth though an indication of them may be seen in well-grown animals. The colour of the mane may differ little from the tawny tint of the body or it may be more or less sharply differentiated by a lesser or greater intermingling of brown or black hairs. A predominance of black hairs in the mane gives rise to the term 'black maned' lions. Both light and dark maned lions with intergradations between the two may be seen in India though 'black' manes are rare. The mane of the lion begins to grow at 3 years and is said to be complete in about 6 years.

Fully and poorly maned lions are found in India as in Africa. Luxuriance or scantiness of mane is probably an individual character; some animals being more hairy than others. The average scantiness of mane seen in the Indian lion is certainly not due to the mane being 'combed' out in the thorny forests in which these animals live in this country.

The Gir Forest, lying within Junagadh State covers nearly 500 square miles of rugged undulating country. It is composed mainly of stunted teak trees, palas, jambul, babul and bhor, and patches of small bamboo with an undergrowth of thorny shrubs and bushes.

This is the nature of the only forest in which lions are now found in India. Their movements within this forest are governed by the movements of the animals which they hunt—cattle, antelope and deer.

The Gir is bare and open during the hot weather. Its water supply over miles of arid country is limited to a few deep pools in the dry bed of the Hiran 'river' and in some of the nullahs, in the vicinity of which game and herds of grazing cattle concentrate. But in the rains, when the forest is overrun with rank

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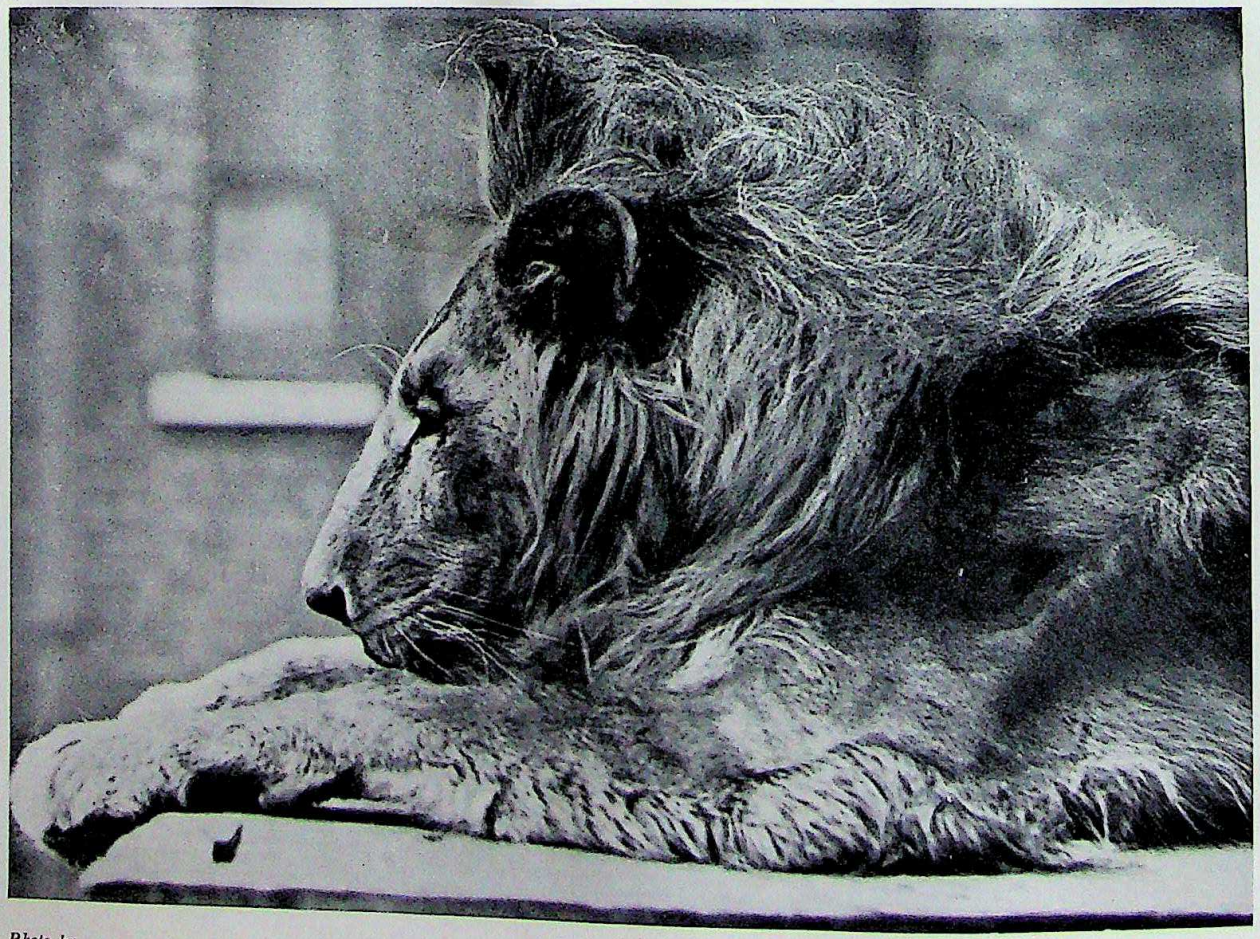

Photo by *F. W. Bond.*

The Asiatic Lion (*Panthera leo persica*, Meyer).

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grass and vegetation, abundance of grazing and an abundance of fresh water in its numerous nullahs results in a wider dispersal of animal life. Cattle graze outside forest limits. The lions following their prey, stray into the neighbouring lands.

Indian lions have much the same habits as African. They rest by day under cover. In the Gir they frequently lie up under the shade of some wide spreading banyan tree. At dusk they come out in quest for food. Their roars are heard through the night more noticeably at dusk and again just before daybreak.

Lions are said to rely mainly on scent and hearing when hunting. When hunting alone, a lion will stalk its prey or lie in ambush within 20 or 30 yards of the quarry, waiting to rush upon and seize it as it strays within reach. But when a troop of lions is hunting together, as frequently happens when there are family parties with half-grown young, a combination of effort has been observed among them. Some of the troop, keeping in touch with each other by low grunts, drive the distracted prey in the direction of others who lying silent intercept and slay the quarry. It is said, that in these combined hunts, it is the lion who drives the game and the lioness which kills it; half-grown cubs when present helping. The same combination in hunting has been observed occasionally in family parties of tigers.

Many observers have written about the social life of lions in Africa. How far these observations apply to the social life of lions in the Gir remains to be discovered. The paucity of numbers, the peculiar conditions under which lions live in the Gir may affect their social behaviour. The underlying cause of animals herding and remaining together is the reproductive instinct: care of the young by the parents prolongs the association. There are some who hold that the lion is a polygamist and that at mating time he acquires a following of females by right of conquest. Single lions with an attendant troop of females are frequently seen but it has also been observed that a lion will leave the troop and go off to live in seclusion with a mate.

There appears to be no particular breeding season. In the Gir the majority of lions appear to mate between October and November and the young are born generally between January and February. Cubs born during the wet season are less liable to survive—conditions in the forest are unfavourable to them and food is scarce. The lioness has her first litter when she is about 2½-3 years old. The period of gestation is 108 days. In the Gir forest the ordinary litter numbers two, frequently three. In the wild state the young are produced at intervals of at least 18 months to two years. The milk canines of a lion cub are not replaced by the permanent teeth till it is about a year old and up to that age the young lion is said to be comparatively helpless in fending for itself. First sharing in their 'kills', with growth the young lions improve their prentice efforts at killing and finally attain mastery in their craft. A number of lionesses with young may associate to form large troops. This herding of females and young is not an unusual feature among social animals. Among lions it probably simplifies the problem of food supply. Equally

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common is the forming of societies of young males. Young lions when able to fend for themselves may band together. They in turn join up with young lionesses and so form the nucleus of fresh troops. Old lions passed the capacity to hold their own against rivals lead solitary lives.

Within historic times the lion inhabited Northern Greece and Macedonia. Its range extended through Persia and Mesopotamia into the plains of Northern and Central India. Lions may still survive in the wilder parts of Persia and in Mesopotamia; in India they are found only within the province of Kathiawar and there only in the Gir Forest.

Man, the agent who exterminated the lion in Europe and other parts of Asia, was probably mainly responsible for bringing it to the verge of extinction in India. Even in parts of Africa lions are steadily retreating before European settlement. The bolder, more confiding habits of the lion, its herding instincts, the open nature of the country in which it lives provided the opportunity for its destruction in India and elsewhere. Even in the Province of Kathiawar, where tigers do not exist and where no struggle for supremacy between these two giants of the tribe could have taken place, the lion was slowly driven from the Barda and Aleche hills, from parts of Dhrangadra and Jasdan as a result of human settlement and the progress of cultivation.

The number of lions in the Gir is computed to be well below a hundred. It is feared that the small stock will deteriorate through inter-breeding. The laudable efforts of the Junagadh Durbar have so far saved this animal from complete extermination in India, but under existing circumstances it is essential that the neighbouring States should co-operate by refraining where possible from shooting such lions as stray into their borders.

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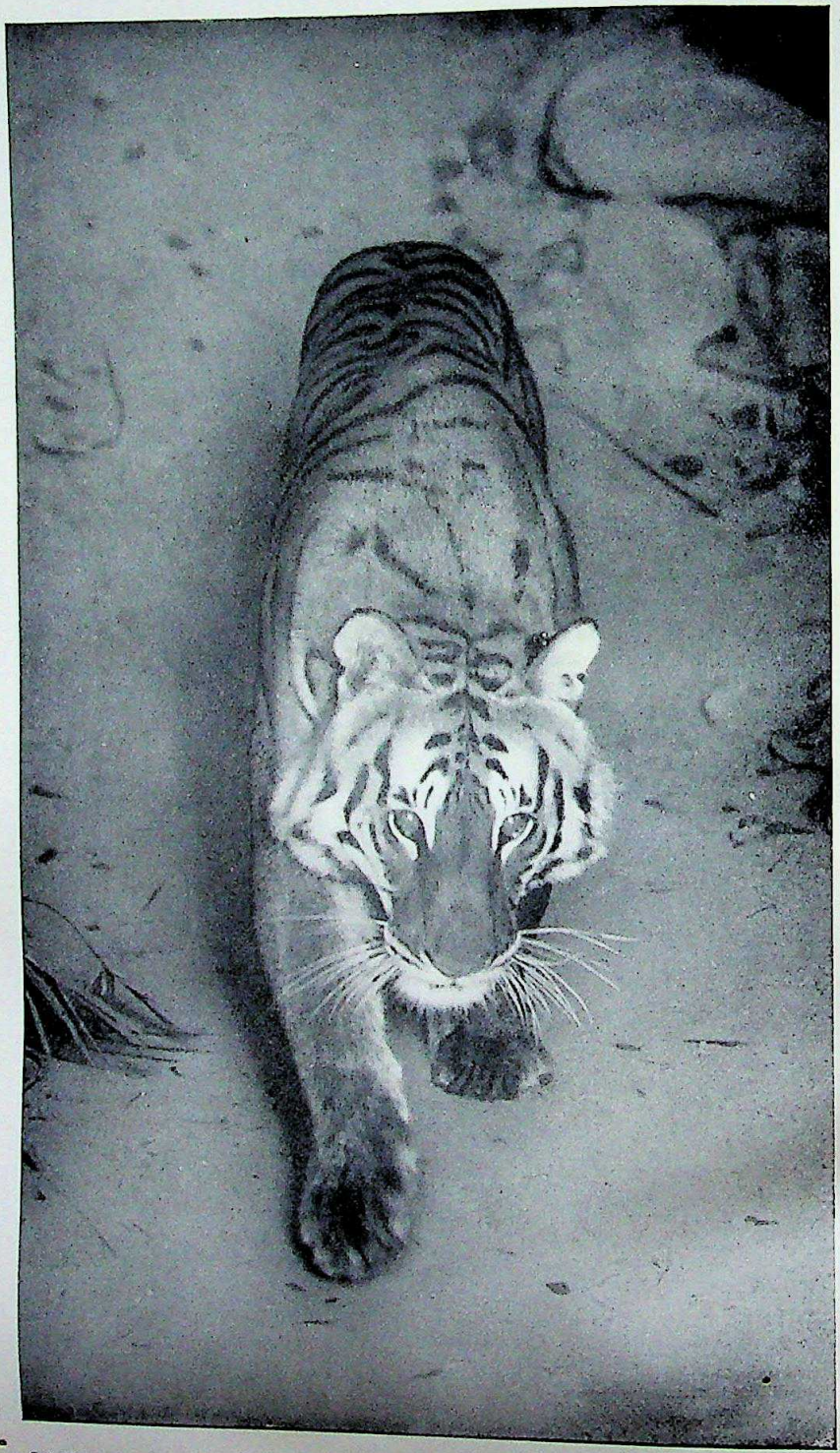

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The Tiger (*Panthera tigris*) Kanger Collection, Haridwar *F. W. Champion.*

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THE TIGER (*PANTHERA TIGRIS* LINN.).

Like the human, the animal population of India has its foreign element. Our wild animals include many species which have migrated into India from countries far beyond our frontiers. Prominent among these is the tiger. Though intimately associated with India—the home of the tiger—the country of its origin is believed to be Central and Northern Asia.

Animals which have originated in a particular country have spread over and colonised great portions of the Earth's surface. The country of their origin is traced sometimes by the location of their fossil remains. The earliest known remains of the tiger—indistinguishable from those now living, were discovered in the New Siberian Islands well within the Arctic Circle. Time was, when under a genial climate, Northern and Central Asia supported a rich vegetation and a varied and abundant animal life. Fossil remains of animals discovered in this now bleak and desolate region reveal the past existence of a great variety of animals. Among them were reindeer and red deer, elk, bison and antelopes which, in their day, were preyed upon by tigers, lions and other carnivores.

From Northern Asia, the Tiger extended its territory over the greater part of the Continent, establishing itself wherever conditions were favourable. It did not colonise the high tableland of Tibet, where a combination of desert and arctic conditions prevail, nor did it enter the great Palaearctic Desert which stretches from the confines of Sind and Baluchistan through the greater part of Persia, Mesopotamia and Arabia. The most westerly limits of its migration appears to be the eastern slopes of the Caucasus, the forests of the Elburz Mountains, which lie between the shores of the Caspian and Persia and the northern frontiers of Afghanistan. It is still found in these regions. From the Persian border —its territory must have extended, or may still extend, through Turkestan into Northern Asia. Today, the Tiger survives in Amurland and Korea, in Eastern Siberia and in Mongolia and Manchuria. Southwards, its range extends through China into Burma, Siam and the Malay countries reaching its most southerly limits in the islands of Java, Sumatra and Bali. We are unable to conjecture how long ago the Tiger entered and established itself in India. Its absence from Ceylon suggests its arrival at the most southerly point of its distribution in this country after the land-bridge between India and Ceylon had disappeared. It was prevented from colonising the island by the deep intervening seas. That the Tiger was established in India fifty centuries ago is again suggested by the recent excavations at Mohenjodaro, where the records of a pre-Aryan civilization, whih flourished 5,000 years ago include numerous seals engraved with figures of the tiger.

The Tiger apparently entered India through the hill ranges of Assam. It colonised the thickly forested southern slopes of the Himalayas and subsequently established itself over the greater part of the Peninsula, avoiding its treeless and desert portions.

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Variation in Tigers.

It will be seen that the tiger, unlike the lion, is exclusively an Asiatic animal. Throughout Asia there is but one species. Pocock recently summarised the external difference of tigers in different Asiatic countries. He considers that it is possible to distinguish eight races. The Indian Tiger (*Panthera tigris tigris*) is accepted as the typical tiger—a standard for comparison with the tigers of other countries. It is described as a rich coloured, well-striped animal with a short coat. The Caucasian Tiger is distinguished by a tendency to brown both in body colour and stripes. More or less distinct races are said to inhabit Mongolia, Manchuria and Amurland, Northern and Central China, Sumatra, Java and Bali. But series of skins and skulls from all the countries where tigers are found are required for comparison before we can arrive at definite conclusions as regards the extent of variation between the various races. Little is known even about the Indian Tiger. We have still to learn whether the tiger varies in different provinces in India and what differences in its colouration are produced by season or age. Individual variation is great.

Though tigers living in the more humid forests are generally darker and richer in colouring, pale and dark animals may be found in the same forest tract. Again the number of body stripes appears to have little relation to the part of the country in which the animal lives. The number varies in the same district. Some of the characters which distinguish different genera or distantly allied species of animals may have an adaptive significance. But the trivial differences seen in what we describe as sub-species, varieties or geographical races of an animal may have no adaptive importance in its mode of life and little adaptive relationship to the environment in which it lives.

Tigers in Northern Asia assume a heavy winter coat which is shed during the spring. Indian tigers go through a similar though less striking change. They moult their finer winter coats on the approach of the hot weather: the moult is at its height in March.

Size of Tigers.

Opinions differ as to whether the Indian Tiger equals the tigers of Northern Asia in build. Sportsmen in this country have argued about the size of tigers for well over a hundred years. Published records fluctuate between 9 and 14 ft. and some attain even more ambitious lengths. The varied methods used by sportsmen in measuring tigers would give widely different results if applied to the same animal. A stripped skin or a generous tape over curves yield remarkable, if inaccurate results. So might a man add to his height by taking in the contours of his body. A straight line measured between pegs driven at the extremities of the tiger's head and tail should be adopted as the standard to be followed by all sportsmen. It is preferable to register separate measurements of head and body, and the tail. A tiger measuring 10 ft. 7 in. on this basis would be a very large animal. Few Indian tigers exceed 10 ft. in length—the majority fall short of this limit.

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The average length of a tiger is 9 ft. to 9 ft. 6 in. The average height 3 ft. to 3 ft. 6 in. The measurements of the skull may provide an index of the size of a tiger. The length is taken in a straight line between the end of the bony ridge which surmounts the braincase—to a point above the incisor teeth. On this basis the tigers of the Nepal Terai show a slight superiority in size over the tigers of Central and Southern India; though tigers as large as any North Indian animal may be found in Kanara or further south. The weight of a tiger averages between 400 and 500 lbs. Individuals far exceeding this weight have been shot. Females are smaller in build. The average length of a tigress is 8 ft. 6 in. The average weight about a 100 lbs. less than the male. Four to five hundred pounds of flesh and bone express the tiger's massive build. Yet, his heavy frame is cast in lines of perfect symmetry and endowed with astonishing suppleness of movement. His massive head, his muscular body, which even in repose reveals the immensity of its latent strength, his rich colouring give the tiger a magnificence which is unequalled by any of the great cats.

Kinship between the Lion and the Tiger.

There is a close kinship between the Lion and the Tiger. There is so much individual variation in both animals that it is difficult to find any constant point of difference in the skeletal structure of the two. What is written in description of one will apply equally to the other. On the average the skull of a tiger is more vaulted and has narrower nasal bones. The facial part of the skull is shorter in relation to the cranial portion. This gives the tiger a greater flatness of face when compared to the lion. The differences between the two are mainly skin deep. Even the tiger-like pattern of many lion cubs indicates the close kinship between the two animals. The mane, so associated with the lion, is not constant in that animal and many tigers wear a ruff of lengthy hairs about the neck and face which is as full as the mane of some lions.

The Tiger in India.

In India the tiger is found under varying conditions of climate and environment. He has left his tracks in the winter snows of the Himalayas at an altitude of 10,000 ft. He lives in humid evergreen forest or in dry open jungle, in grassy swamps or in an amphibious terrain of trees and mud and water.

No statistics are available to give an idea of the number of tigers living in different provinces in India. The opening of the country to settlement, the extermination of game animals, has driven the tiger from districts where he was once common. Where tigers are still found, their numbers probably fluctuate. Though supreme in his forests, the tiger is but one of a community of animals living within a particular area, and is so governed by all those forces which regulate the constantly varying density of its animal population. Changes in the environment in which the animal community lives, the inter-relationships existing between

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its members are some of the factors which control the number of animals living in a given locality. The hot weather with its scarcity of grazing and water supply may cause a concentration of cattle and game in a favoured locality and with it, a concentration of animals which prey upon them. The monsoon effecting a complete change in plant life, in water supply, in the abundance of parasites, results in a greater dispersal of animals. Factors such as these may reduce or increase the number of tigers living in a given area. Given continuity of favourable conditions a tiger may settle in a favoured locality for an indefinite period and establish his rights within his territory. On his death, his domain is taken over sooner or later by a successor.

Three things are essential to the tiger's territory—the neighbourhood of animals of a size commensurate with his needs, ample shade to sleep in, and water to quench his thirst. An emigrant from cooler northern climes, centuries of acclimatization have left him still intolerant to tropical heat. The tiger needs shelter under cave or covert in the day time from the heat, his pads may blister from long contact with the fiery ground, and many of his kind, particularly during the hot weather take to water and lie in it during the hot hours of the day. In common with many nocturnal animals, should the day be cold or clouded with rain, tigers may be up and about. Always their movements must be regulated by the animals upon which they prey. Like them the tiger is nocturnal. But should game be wanting or the opportunity to take cattle by night—hunger may compel a change of habit and make the tiger hunt by day.

How Tigers Hunt.

Ordinarily the tiger when hungry goes out to seek his food shortly before sunset and ends his hunting at break of day. He will go through cover if need be, but, like most forest animals he prefers the beaten track. He follows the accustomed trail of game, or takes a jungle path, road, a forest fire-line, or an open water course. In the gathering dusk he moves slowly and silently, stopping now and then. His acute hearing makes him conscious of any sound which betrays the presence of his quarry. His eyes attuned to work in the dark—detect the slightest movement, though like all cats, the tiger is less quick in the recognition of objects which are still. Many writers of experience maintain that a tiger hunts with his ears and eyes and makes little use of an enfeebled sense of smell. While the consensus of opinion appears to uphold this view—there are other factors which require consideration. There are those observers who have seen a tiger pick up the fresh ground scent of an animal, and turn in his course to follow it. Another tiger has followed the scent of a wounded quarry and yet another was observed to trace a kill which was dragged from its site. The behaviour of a particular tiger under given circumstances—his failure to discover his food by scent, to wind a man sitting in a tree—provides no evidence that tigers do not use their sense of smell. It is a faculty of no small importance to a beast of prey. To live a tiger has to find, to

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outwit and to overcome his prey. He must do all this in competition with his own kind and he is compelled to secure his quarry under varying circumstances wherein any one of his faculties may be at disadvantage and wherein success will imply a reliance on others. We know little as to the extent to which nocturnal animals rely on vision in getting their food. We know less about the inner working of the animal mind—we attempt to read it from external behaviour—behaviour which must vary with the individual and with circumstances. It is probable that all the tiger's senses play their purpose in his life—the predominance of any one of his faculties depends upon the individual and equally upon the factors in the environment which are then influencing his action.

In his quest for food the tiger's progress is described as the 'flowing past of a phantom'. His sinuous gliding movement is effected by the simultaneous advance of the limbs on each side of his body. Ordinarily his feet on each side leave a double track, the impression of the hind foot being a little in advance of the fore-foot. The imprint of the fore-foot is larger, rounder and more splayed out than that of the hind. The difference is usually less marked in the spoor of a tigress.

But the type of spoor a tiger leaves varies with the gait of the individual and depends equally upon what the tiger is doing. A slowing down of movement impelled by rousing interest on increased caution may sometimes be read in the reduction of space between the imprints of the fore- and hind-feet. The reduction may end in the feet imprinting a single track, the hind foot being placed over the exact spot vacated by the fore foot. But this is not the impress of care free movement but of highly controlled and deliberate action.

A tiger hunts by stealth. He stalks his animal or lying hidden takes it as it strays within reach. Whether cattle-killer or hunter of wild game, the tiger is accustomed to the habits of his prey and knows how and when and where to find it. His habit is to hunt alone. When in a family party his hunting may be in the nature of a drive; the tiger trying to rush the quarry in the direction of another lying concealed. Such combined hunts are frequent among lions. They have been less frequently observed among tigers.

The Killing of the Prey.

A tiger follows no rule in the killing of his prey. He passes from the awkward attempts of the young to the power and mastery of the adult. Equally must he adapt his strategy to the nature of his quarry and the conditions of its taking. There is the haphazard seizure of an animal in flight where desperate claws and teeth strive to retain and hold the moving body, or the timely leap, which takes the quarry in its stride and sends it to the ground—its neck broken by its fall and the opposing wrench of the tiger's hold. Different must be the killing of a standing animal. There are two common ways in which a tiger does this. Coming with slow deliberate approach or bewildering rush he dips under and takes his prey by the throat, draws down and pins its

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head to the ground and maintaining the pressure of his grasp, strangles his animal. Or, rearing up on his hind legs, he seizes the animal's neck in his jaws and bringing his arms down about its head and shoulders, takes it in violent hold and bears it to the ground. The ferocity of his strangle hold, his ruthless violence in forcing his prey to earth may twist the neck of a heavy animal, or bend it back upon itself till it breaks under the strain and the opposing stress from the body as it falls or is forced to the ground. The neck is not always broken. To break the neck of his prey is not perhaps a tiger's deliberate purpose. Like all the big cats he tries to take his animal by the neck or throat and strangle it. The neck, when broken, breaks from the manner of its seizure, the force exerted and most frequently from the opposing strain of the falling body.

A large animal may be seized by the hind leg. The leg is bitten into above the hock, its tendons severed and the bone broken. With one or both legs broken, bison, tsaine or buffalo despite their bulk and power, fall easy victims. They are killed as they weaken. Tigers in Burma invariably break the legs of a large animal before killing it. The method is less common in India. It is suggested that the more open nature of forests in India gives the clearance a tiger needs for his normal point of attack—the neck or throat. Not much blood is shed in the tiger's process of killing. His jaws maintain their grip, though his animal is dead and its struggles have ceased. The fangs buried in the flesh obstruct the flow and prevent the spilling of much blood. There is no evidence to show that the tiger sucks the blood of his prey.

The Tiger and his Kill.

A tiger brings to his eating the same ferocity and lust which he displays in the killing of his quarry. Savagery when feeding, a common trait in animals, is a demonstration against possible interference. With it, the tiger combines a wild animal's instinctive anticipation of danger. When feeding, or coming to his kill, any sound the reason for which is not apparent may cause the tiger to disappear like a flash. While he desires to hold what he has, his instinct for self-preservation predominates, as it predominates in all animals. Cowardice or bravery, both human characteristics are inappropriate to the description of animal behaviour. Animals do not possess an exalted ethical code. Strong or weak, they normally obey the primary instinct which is to preserve life. Endangering life in defence of themselves is but obedience to the same instinct. Though supreme in his jungles, the one rival a tiger must fear is another tiger who can take his food from him and destroy him in the taking. He fears and avoids Man, but competition from his own kind is the more intimate factor in his struggle for existence. This explains the common impulse of the tiger to drag his kill under cover where he can eat it in greater seclusion—though freedom from interference may induce or circumstances compel him to feed in the open. In eating, his first and most usual choice is the hind quarters. In this he differs

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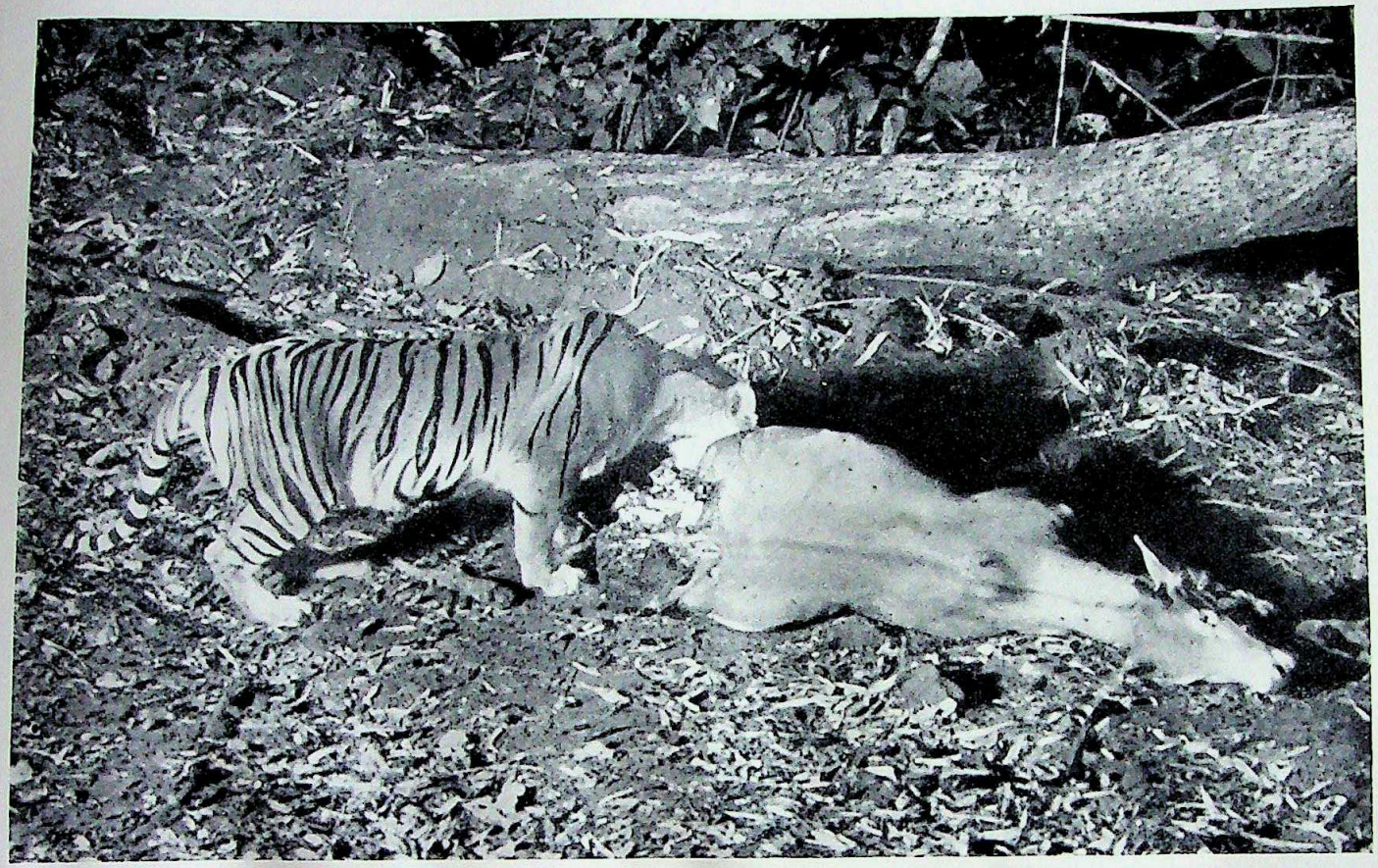

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from the Leopard whose custom is to start his meal in the region of the breast bone or stomach. Like the lion, a tiger generally disembowels the body and places the entrails to one side. It may take a tiger the best part of two hours to finish the hind quarters of a bullock and a hungry tiger may eat the greater part of the body at a single meal. The remains of the carcase are left exposed or dragged and hidden under bushes or even concealed with uprooted bunches of grass when no cover is near. The tiger's neglect or care of his preserve of food must depend much upon the density or openness of the country in which he is accustomed to hunt, and the chances or frequency of interference with his kills by vultures and animals which discover and eat it. The abundance or scarcity of food may equally govern his actions.

After satisfying his hunger the tiger goes to drink and then to sleep either in the vicinity of his kill or away from it. Freedom from disturbance, conditions of cover, the need for cool shelter are all factors which influence his behaviour. When darkness sets in or even earlier he returns to his kill and may continue to repeat his visits till the carcase is finished. Or, for various reasons he abandons his quarry.

From hunger or individual preference a tiger may eat a carcase not of his killing however putrid. His usual habit is to feed on his prey when killed. He may even feed on a crippled animal before life is extinct. Ordinarily a period, which may be anything between 4 and 7 days, elapses between successive kills. There is sometimes a simultaneous killing of a number of individuals in a herd of cattle. It is generally the work of a young tiger or of a female with cubs.

Cattle, various species of deer, nilghai, pig and porcupine are the common prey of the tiger. Larger animals like bison, tsaine and wild buffalo, bear and leopard are killed occasionally. Tigers living near villages are said to feed largely on cattle. Whether cattle killing becomes habitual in the individual is not definitely known. It may develop in an individual with age, when the taking of more active and vigilant prey becomes difficult. Unlike the panther, the tiger's association with Man is limited to forest areas, where a variety of food is available and wherein limitation to domestic prey becomes less imperative. It is significant that certain districts in Southern India, where cattle are in abundance, but where deer and other large game are now all but exterminated, are now devoid of tigers, which suggest that the presence or absence of game is a factor in the tiger's selection of a habitat.

The tiger is not usually dangerous to man except when wounded or perhaps under stress of sexual excitement. A tigress with cubs may make a demonstration of frightfulness, charge home or even desert her cubs.

The man-eating tiger is fortunately uncommon. Insufficiency of natural food or causes which prevent the securing of it may convert a tiger into a man-eater. The vice is acquired in age or in youth. The chance killing of a man may initiate the habit in a young animal, or an old or disabled tiger may take to man hunting. Familiarity with the presence of Man subdues his

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fear, and hunger compels him to attack what his experiment discovers to be the easiest prey. Man-eating appears to be more frequent in females. Difficulty in finding sufficient food for the cubs suggests a reason. Such cubs trained to the vice by their parents may retain the habit through life. In individual instances man hunting like cattle killing, may be a tradition passed on from mother to offspring. This perhaps is the explanation of the repeated occurrence of man-eaters in certain districts of India and their comparative rarity in others where tigers are equally or perhaps more common.

The Calls of Tigers.

In many of his habits the tiger resembles the Lion, but a tiger is more silent. Tigers seldom roar. When they do, their roars can be deceptively like the roar of a lion. Deep and thrilling, the repeated gusts of sound increase in volume and fill the air with their reverberations. This roaring is said to be a mate call. It is sometimes uttered when the tiger rouses at dusk preparatory to going out or while in quest for food. There is the coughing roar which may prelude attack and the 'whoof' which expresses surprise and alarm and a purring note made by blowing air through the lips with which he gives vent to when expressing contentment.

A peculiar call of the tiger, which is much like the belling of a sambhar, has occasioned much comment. The calls of the two animals are so similar that it is difficult to distinguish between them in forests where both tiger and sambhar live. This peculiar call is not the tiger's ruse to decoy a sambhar. It has no concern with his hunting. One suggested explanation is that it is a mate call. The tiger utters it when seeking or keeping in touch with a mate. It is indicated however that the call has been frequently uttered as a direct result of disturbance by human agency and as such is purely an individual expression of surprise, suspicion or alarm.

The Mating and Breeding of Tigers.

The tiger is by nature a solitary and unsociable animal. The bond which brings and keeps tigers together is the reproductive instinct and the subsequent care of the young. This is the general basis of social life in all the lower animals. In India many tigers seem to mate after the rains and the majority of young are born between February and May. We do not know whether the tiger is monogamous. The acquiring of more than one mate will depend, among other factors, on the number of females in condition to breed and the dominance of a particular tiger over other males in the area. Tigers with more than one adult female in train have been seen. Whether the association between a male and female is ever permanent is not known. It appears to end or to be interrupted when the cubs are born. The summary treatment of the cubs by the male may induce the mother's desire for seclusion at this period. It has been observed however that a family party consisting of a tigress and her cubs frequently includes an adult male. The presence of the male may suggest an uninterrupted

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association of the parents or it may indicate the renewal of sexual activity in the female and the acquiring of a mate. We have no definite knowledge regarding the cycles of sexual periodicity in the larger Felidae. It is suggested that tigers breed after intervals of not less than two or three years, the period during which the cubs live under parental protection. The mother may however be accompanied by cubs of more than one litter—the previous cubs are then fairly well grown and almost in a condition to fend for themselves.

The period of gestation is fifteen weeks. The tigress gives birth to cubs in the jungle, or in a cave or rough shelter of rocks. As many as six cubs may be born in a litter—usually not more than 2 or 3 survive. The cubs are soon able to wander about their lair and when about six months old regularly accompany the mother. The largest family party seen by Mr. Dunbar Brander consisted of an adult male, two full grown females and three cubs nearly as large as the tigress. Such a family party in quest for food may hunt in co-operation—the hunt assuming the nature of the drive. The practice is more common with family parties of lions and provides an opportunity for the training of the young. That the mother tigress trains her cubs to hunt has been observed. Her method is to disable an animal so that it cannot escape the onslaught of her cubs who come in and take a share in the killing. It is probably at this period that the tendencies of the individual to cattle or game killing or even man hunting are formed.

Various observations on the behaviour of individuals have given us our impression of the tiger and the rôle it plays in Nature. With the facts that we gather we attempt to predict what an animal *will do*. This is the aim of our observation. While the individual animal obeys the fixed instincts of its species, its behaviour is influenced by parental tradition—by the experience it acquires through life, by its physical environment, by its changing relationships with the animal community in which it lives. Our knowledge of the true life of the tiger can only come to us by a greater knowledge of the factors which influence its life. We must study not only the animal but also the stage upon which it plays its rôle. We have still to learn more about the tiger's reactions to the varied conditions of its physical environment, to climate, to season, to new situations and to the animal community in which it lives. We have still to learn about its migrations and movements, its sexual relations and its social life. Such knowledge can only come as the result of continued field observation, and more especially from controlled systematic investigation—surely worthwhile in an animal which plays so definite a rôle in the economy of Nature in this country, and which is so surrounded with immemorial romance and interest.

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THE PANTHER (*PANTHERA PARDUS* LINN.).

Panther is a word of Greek and Latin derivation meaning 'all animals'. Greek and Roman writers applied it to many predatory creatures, among others the Cheetah, the Weasel and the Lynx. From common usage it is now a recognised name for the Leopard in India.

In its structure a panther exemplifies all those characters which unite and distinguish the Great Cats (*Pantherina*) from the rest of their tribe. It has been shown that in Lions, Tigers, Panthers, Jaguars and in the Ounce, the hyoid bone is loosely attached to the skull as a result of the imperfect ossification of the arms of this apparatus. In all these animals the pupil of the eye does not narrow to a slit, but retains its circular form when contracting. Again in all of them the patch of horn-sheathed spines on the surface of the tongue displays a distinctive position. Now if the skulls of a lion, tiger, panther or jaguar are compared it will be found that they are very similar in form. Except for differences in size and a few slight specific characters there is little to distinguish between the skulls of these animals. Agreement in their skeletal structure suggests their close affinity.

It is true that the Panther and the Jaguar have disinctive colour patterns. But young lions are also spotted or striped and the vestiges of the panther's 'rosettes' are sometimes developed in the markings of a tiger. Colour differences between these animals are less fundamental than they appear.

Panthers and jaguars are lower in stature than tigers or lions. They are less massive in build, longer in body and more lithe in limb. These distinctions are probably associated with their tree-climbing habits. Their roars are remarkably alike but normally quite different from the roaring of lions and tigers. It is believed that the Panther and the Jaguar are descended from a common ancestral stock which originated in Europe or North Asia: that the progenitors of the Jaguar probably migrated into America by way of Northern Asia and established the species in the New World.

Distribution of the Panther.

The primeval forests of Europe and North Asia are indicated as the region from which the Lion, the Tiger, the Panther and the Jaguar spread into various countries which they now inhabit.

Fossil remains of panthers, indistinguishable from those now living have been found in the cave deposits of the Pleistocene Age in Spain, France, Germany and England. At the present time the Panther survives in Europe only in the Russian Province of Kuban, north of the Caucasus. But its territory covers practically the whole of Africa and Asia.

In Asia its range extends from Palestine and Syria through Persia to Manchuria and Korea. Southward its territory reaches through China into Burma, the Malay Peninsula and Java and covers practically the whole of India and Ceylon.

Whether the Panther established itself in India before the

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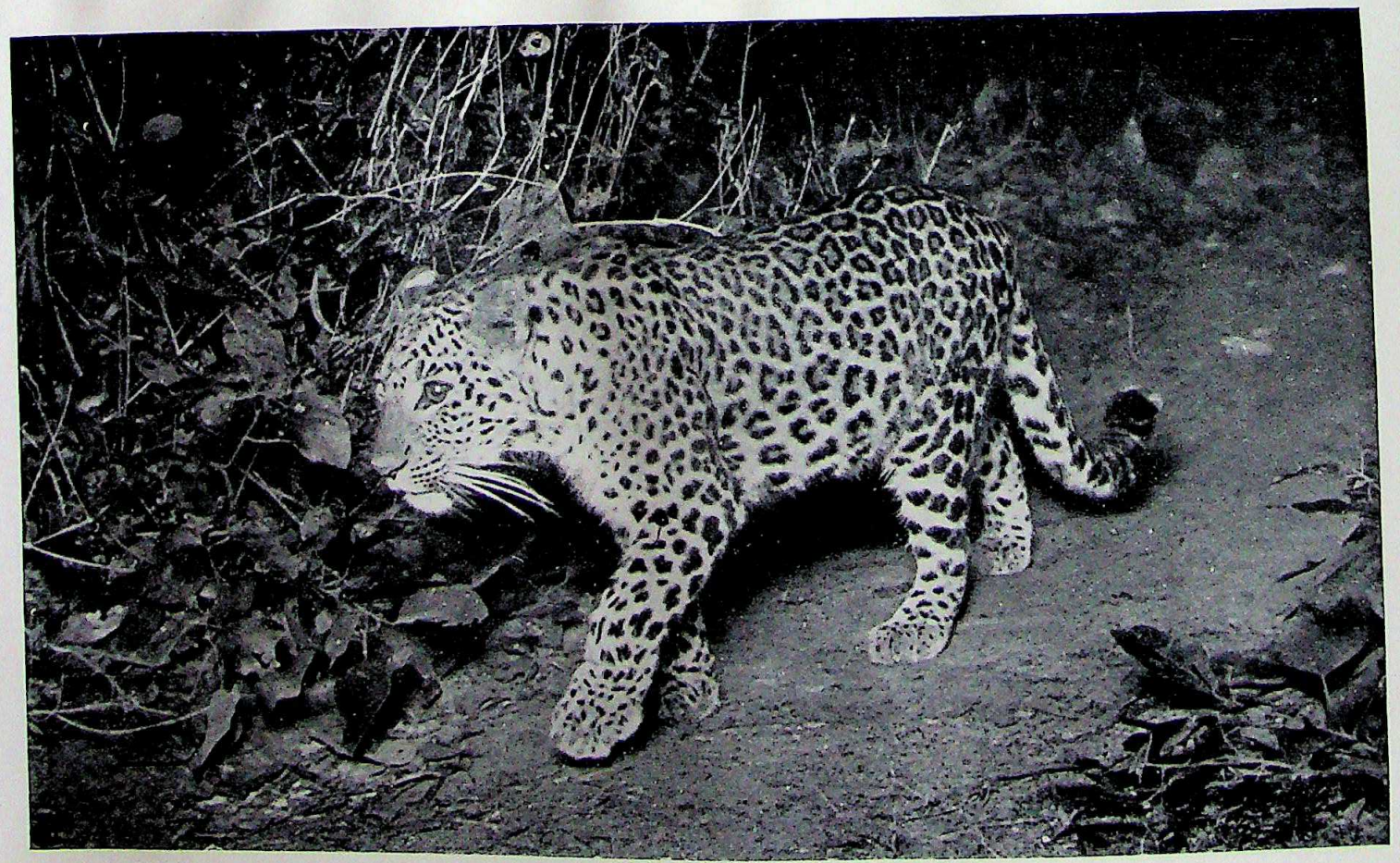

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The Indian Panther (*Panthera pardus fusca*, Meyer).

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Lion, we do not know. It may have accompanied or preceded it. Both animals probably entered India from the West. But like the Tiger, the Panther may have also migrated into India through the hill ranges of Assam. That it established itself in Peninsular India before the Tiger is suggested by its occupation of the Island of Ceylon, where tigers are not found. Earlier colonisation of the Peninsula may have enabled the Panther to enter Ceylon over the land-bridge which once connected the Island with the main land. The Tiger's passage, it is presumed, was prevented by the disappearance of this bridge.

Variations in Panthers.

Through the extent of a range covering two Continents there is but one species of panther, living under contrasting conditions of environment, of climate, temperature and rainfall. Such varied conditions of life may have influenced the minor but more or less apparent distinctions seen among panthers in different countries. Variation is especially marked in Asiatic panthers whose colour may range from the sandy grey of the Persian panther to the golden yellow of the Indian and the rusty red of the Javanese animal. Distinctions are also seen in the boldness, the spacing and the size of the rosettes and in the texture, length and density of the coat.

Eleven more or less distinct races or varieties of panther are recognised in Asia. Three are found within the Indian Empire.

The Kashmir Panther (*Panthera pardus millardi*) is distinguished from the Indian by its softer, more furry coat, its grey buff colouring, its small, close-set, thick rimmed rosettes.

The Sind Panther (*Panthera pardus sindica*) is known only from the barren Khirthar hills of the Sind-Baluch border. Its coat is thick, but harsh and rough; its colouring brighter than the sandy grey of a Persian panther but distinctly more pale than the average Indian animal.

The Indian Panther (*Panthera pardus fusca*) ranges from the Himalayas to Cape Comorin and Ceylon. As far as is known, it is indistinguishable from panthers found in Assam and Burma. A typical panther from the Indian Peninsula is a sleek short haired animal with a fulvous or bright fulvous coat, marked with small, close-set rosettes. There is however considerable variation of colour in Indian panthers. At present it is not possible to define the limits of such variation or to correlate it with particular areas. Panthers living in dense evergreen forests are generally richer in colouring than those found in drier open country. In the forests of Burma the ground colour of the Panther is generally a bright chestnut.

Among abnormal phases of colour, black is the commonest. The black of a panther's coat may be as deep as the black of its spots, which are then only discernible in bright light. The black may extend to the tongue and in varying degrees to the gums and palate. The eyes are sometimes a curious blue. A black panther is not a distinct species. Black and normal coloured cubs may be produced by the same parent. The abnormal colour is due to

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the excessive presence of a pigment called melanin which darkens the hair and other parts of the body. Melanism is common among animals which have a supra abundance of this pigment. The condition is common in panthers, exceptional in tigers. Tigers on the other hand reveal a greater tendency to albinism a condition opposite to melanism in which the dark pigment is entirely or partly wanting. Albino tigers are not uncommon; albino panthers very rare. Melanism like albinism may arise as an individual variation, but when either condition appears in many individuals in a given area, it is probably due to germinal variation, and inter-breeding among such individuals results in the perpetuation of melano or albino forms; particularly if preferential mating takes place. This is instanced perhaps in the successive generations of white tigers in the Rewa State and the comparative abundance of black panthers in certain areas. The causes which give rise to melanism are not known. Black panthers are rarely found in drier and more open country. One is recorded from the Central Provinces and one from Idar State. They are plentiful in Java and in the Southern parts of the Malay Peninsula, and are known from the evergreen forests of Burma, Assam, Nepal and South-Western India. They are quite common in the forests of Malabar. Whether the colour of a black panther is adaptive to the darker conditions of these dense forests, we do not know. Its coat is without obvious pattern. The spotted coat of a panther blends with the checkered light and shade of the jungle by day and converts it into an evanescent phantom in the darkness or in moonlight. Yet both black and spotted panthers thrive in the same forests, suggesting that pattern may be of no essential significance in life of the animal.

There is marked variation in size among Indian Panthers. Some grow to the size of small tigers, others are scarcely larger than some of the lesser cats, though fully adult. It is suggested that differences in size may have some relation to the habits of the animal and that in the Central Provinces and in the drier parts of the Peninsula panthers which live habitually on game within the forests are larger than those which seek their food about towns and villages. Dunbar Brander gives the average dimensions of a forest panther as 7 ft. 5 in. and its weight at about 150 lbs.

On the other hand small panthers are generally common in the hill forests of South India and in the more wooded portions of the Himalayas. The panthers which frequent the cliffs and precipices of the Anamallais and Nelliampathies are distinctively small in build and size. The smallest race is said to be found in the forests of Java.

The average size of a male Indian Panther is 6 ft. 8 in. The tail varies much in length; its length when included with body measurements may give a wrong impression of the size of an otherwise poorly-built animal. Separate measurements of head and body, and of the tail should always be recorded.

Distinctions in size and in the shape of the skull have led to the belief that there are two species of panther in India. Such differences are due mainly to sex. The skull of the adult male

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panther is larger with larger teeth. Its cranial portion is more elongate, less rounded than in the female and carries a more prominent median crest.

While there is local variation among panthers there is also individual variation affecting both structure and colouring. Individuals sometime exhibit a complete disintegration of markings far exceeding similar deviations in pattern in tigers. So complete may be the fusing and breaking up of the spots, that a particular skin obtained in South Kanara gives the impression of a black panther streaked and spotted with yellow.

The Panther and its Environment.

The Panther, as we have seen, is found over an immense range of territory, covering practically the whole of Asia and Africa. In practice an animal is limited in its distribution, by its habits and its reactions. Its reactions to environment and other influences are so adjusted that it chooses places to live in which are suitable to its needs. A tiger's range is limited by its need for the shade and shelter of forest, for continuous tracts of cover. The lion chooses drier, more open country. Both tigers and lions require the propinquity of large animals for food. A panther is less bound by the physical condition of its environment. It is more tolerant of the sun than the tiger and less dependent on shelter from its heat or on the nearness of a water supply. It thrives in a parched treeless terrain of rock and scrub or in rain swept forests, under extremes of heat and cold, of dryness or humidity.

A panther can subsist on a variety of small creatures which would give no adequate sustenance to a tiger. It can find shelter and security in the scantiest cover. Its adaptiveness to varied conditions of life enable it to overcome those factors which limit the increase and confine the range of lions and tigers.

Diversity in conditions of life produce in the panthers a variation in food and habits.

The Village Panther.

Very considerable must be the influence of Man on the life and habits of the species. The panther's ability to live under conditions where no tiger would survive brings it into freer and more constant touch with Man. As such it is able to profit to a greater extent from such opportunities of food getting as are provided by human agency. As such it has become a greater potential scourge on human life and human property. The panther living near human settlements, particularly outside forest areas preys mainly on domestic animals—on cattle, sheep and goats, on ponies and donkeys and most commonly on dogs. It finds regular opportunity to take grazing cattle, to intercept stragglers from flocks and herds returning home at dusk, to raid cattle pens and enclosures or carry off dogs at night. For the village panther the problem of food getting is simplified. The food is concentrated within a limited area, the occasions for taking it are more or less constant and identical. Further competition for the food is frequently reduced by the elimination of rival beasts of prey for

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whom the environment is unsuitable, and the prey itself, its alertness enfeebled by domestication, is easily secured. The influence of these conditions on the life of the Panther vary in their effects on the individual. Domestic prey if easily taken must be taken in conflict with Man and such competition usually develops great boldness, cunning and resource in animals. We have come to associate these attributes with the Panther because of their frequent and singular development in panthers living under the educative influence of human association. Nevertheless association with Man seldom changes a panther's instinctive habit of concealment. Secrecy and stealth are the essence of its hunting. Whether it lives in remote forests or in the neighbourhood of towns and villages it maintains its secretive nature, is rarely seen and hunts mainly under cover of darkness.

Faced with the sudden apparition of man in regions rarely entered by him, a panther or a tiger usually reveal no more than the wild beasts' curiosity or suspicion of the unknown. Ordinarily they betray no undue fear, stare a while at the intruder and go quietly away. Experience gained from association with Man may exaggerate this reaction in a panther, may develop in it great fear and suspicion. While familiarity with Man, success in escaping harm, will beget in another outrageous boldness, an indifference to human activity, to lights, sounds or movements, and a disregard for human presence even in broad daylight.

Panthers living near human settlements probably maintain this mode of life through successive generations. For the life of the animal is not only the sum of its fixed instincts—a legacy born of the experience of countless ancestors—but also of parental tradition and of experience acquired in life. Hence many village panthers have come to rely mainly on human agency for their food supply. When the supply is maintained it may lead individuals to establish more or less permanent territory in the neighbourhood of towns and villages, and an interruption or failure in the supply to migration to similar environment where the accustomed food is available. While the type of prey the panther is accustomed to hunt is largely a matter of individual habit and upbringing, these habits are induced in parent and offspring by the conditions of their habitat. Changes in the nature of the habitat must produce a transition in habits of life leading from a more or less complete dependence on domestic animals for food to increasing or complete reliance on wild animals as prey.

The Game-killing Panther.

Conditions of life for panthers which live entirely by the killing of wild creatures must be different. Their prey is more varied in character and habit. It is not concentrated within limited zones. It is less sedentary. Seasonal and other changes in the environment influence its concentration or dispersal in a given area. Such changes in the density of the animal population living within a given area bring about the wider ranging habits of beasts of prey.

Equally, as in the case of village panthers, a continuity of favourable conditions must lead an individual or a pair to establish

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hunting rights over a territory sufficiently large to supply food requirements.

Apart from these influences there is the factor of increased competition. Forest areas which support a large and varied assemblage of herbivorous animals equally make possible the co-existence of a varied assemblage of predatory species. Now competition between various carnivores is governed by the size of the prey to which each is more or less limited. The herbivorous species form what is called a 'food chain'. Commencing with the smallest forms predators and prey increase in size so that at the end of the chain we have the largest herbivorous animals which are the prey of the largest carnivores. The competition for food between the tiger and panther is thus governed to some extent by the size of the prey to which each is more or less limited. While the tiger and panther are at the same end of the 'food chain' the panther occupies a lower link. The panther must equally face the competition of its own species and in certain areas it is brought into competition with some of the larger cats, like the Clouded Leopard, and the Golden Cat which take a similar prey.

Again, while the strength and prowess of the predator decides the size and nature of its prey, there are some species like wolves and wild dogs which increase their effective size by the strategy of numbers and are able to enter into competition with panthers or tigers.

These are some of the factors which must influence the life and food getting habits of panthers particularly of those individuals whose conditions of life remain unaltered by the artificial influence of human association. The collection of more concise data concerning the panther's reaction to varying environment, to the animal community in which it lives, to competition with Man and other rivals, its migrations, movements, its acquirement of territory would help us to truer understanding of the life and habits of the animal.

The Panther's Method of Hunting.

Mr. Dunbar Brander indicates that panthers in the forests of the Central Provinces which confine themselves to the killing of wild animals display many of the habits and ways of a tiger. In other words they display the truer habits of their species. Their prey consists of various kinds of deer and antelopes, of monkeys, pigs and porcupines. When food is scarce even birds or reptiles are eaten. Like the tiger, the forest panther follows roads or paths or the beaten track of animals through the forest, or waits in hiding for its prey. It seizes its quarry from the ground or leaps upon it from a height such as an overhanging branch. Deer and other animals following their accustomed path are sometimes taken in this way. Monkeys are hunted in the tree tops.

Watching the movements of its quarry from some elevated perch or rise is a common method of hunting. Wild sheep and goats feeding on open hill sides or village cattle in the plain are frequently watched and stalked from such a position. The panther has a keen eyesight and an acute sense of hearing. Its sense of

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smell is said to be better developed than a tiger's. Opinions differ on this point.

To take its prey by surprise is the basis of the panther's strategy. Its purpose is effected by noiseless approach, an amazing capacity for concealment and a lightning agility in attack. Failure to surprise its quarry and to seize it in the first attempt frequently results in the panther's discomfiture and retreat, even before so humble a quarry as a goat. Tigers reveal a similar trait in their hunting and usually relinquish their prey if they do not succeed in taking it in the initial attack. This is a common trait in the hunting of Cats. A panther's quarry if not small enough to be pounced upon and carried off is seized by the throat and held in a strangle hold. To kill their prey by strangling it is apparently the purpose of the great Cats. The breaking of the victim's neck may or may not follow as result of the seizure. A large and exceptionally powerful panther may break the neck of an animal in the violence and fury of its onslaught. Usually death is caused by strangulation, and may ensue without the infliction of fatal wounds.

As with the tiger, there is no evidence to show that a panther sucks the blood of its prey. Like the tiger it maintains its grip for some time to ensure death. A premature release, as happens when a panther is shot while holding down its prey has resulted in the recovery of the victim.

The Panther and its Kill.

The panther's usual impulse after killing is to drag the carcase under cover to eat it where there is no danger of disturbance. In obedience to this impulse individuals have displayed remarkable ingenuity, eating through the neck or leg of a tethered animal to carry it away. A panther usually commences his meal at the stomach or in the region of the breast bone. The viscera, the flesh of the ribs and the fore quarters are first eaten. The neck and head are left to the last. The unconsumed portion of a panther's kill, if seen early, is remarkably even and clear in outline. The ribs appear as though trimmed with a butcher's knife. A panther may commence his meal on a large animal between the buttocks in the accustomed manner of a tiger. This is said to be the practice of large game-killing panthers. As with the tiger, the unconsumed portion of the carcase is usually dragged and concealed under bushes, put away among the boulders of a nullah or a deliberate attempt is made to cover it with leaves and grass. Though plenty of ground cover is available some individuals prefer to carry and place the kill in a tree. Particular trees may become the regular resorts to which the resident panther of the neighbourhood takes his reserve of food for safe storage. The feat of scrambling up a tree with a full grown cheetal stag in its mouth gives an idea of the strength and resource of an individual panther. Man-eating panthers who have developed this habit may dispose of their kills in the same way.

Dragging the kill away to eat it in hiding, concealing the

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remains on the ground or in a tree are devices for the protection of the food from rivals. All beasts of prey will feed on any carcase they happen to discover. Besides professional hunters there are professional scavengers like hyaenas and jackals, vultures, crows and even eagles with plebean tastes. Food is the burning question in animal society and the habits of all animals are mainly directed to obtaining a sufficiency of it. Having provided for the security of its reserve of food, the panther usually lies up in its vicinity and returns to its kill when darkness approaches. It may return to its kill at any hour of the day, or it may abandon it altogether. Everything depends on the situation of the kill, if secluded or otherwise upon circumstances, upon the idiosyncrasies, the past experiences of the individual and the state of its appetite.

While some individuals display an almost reckless confidence in approach, a panther returning to its kill is usually the personification of cautiousness. The advance to the kill is slow and the panther's movements in its immediate neighbourhood highly controlled and deliberate. It surveys the surroundings both around the kill and in the trees above it. Anything unusual or abnormal may awaken its suspicion and cause an immediate retreat or abandonment of the meal. Boldness in returning to the kill after being shot at or otherwise disturbed is a matter of past experience, or temperament or hunger. A panther fired at over a kill does not necessarily connect the sound with any particular danger. The sudden report is alarming and puts the beast to flight but if no harm has come to him he usually returns.

The kill, as we have seen, is a source of attraction to a number of rivals dangerous or otherwise and the panther's natural instinct is to apprehend the possibility of interference. The existence of tigers in the same forest is a source of danger of which the panther is acutely conscious. Panthers have been destroyed at their kills by tigers or by more powerful rivals of their own species. They have been killed, routed or otherwise deprived of their rights to a meal by wild dogs and hyaenas. That a hyaena or wild dogs in company may be more than a match for a panther is shown by the number of recorded instances in which victory has gone to these animals. At the same time we read of wild dogs or a hyaena being driven from a kill by the onslaught of a panther. The circumstances of the encounter, the advantage of surprise and other factors, which may or may not be apparent to the observer give victory to one or the other of the contestants and obscure conclusions as to their respective prowess.

Very curious on the other hand is the behaviour of animals—habitual victims of the panther in the presence of their enemy at a kill. We read of cattle and deer continuing to graze unconcerned in close proximity to a panther absorbed in its meal. Their behaviour suggests that these animals appear to divine the presence or absence of hostile intent in a traditional enemy and react accordingly. It has been observed in Africa that zebra and other animals commonly hunted by lions are unaffected by their roars by day and seem to know exactly when these roars threaten danger and when they do not.

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The Man-eating Panther.

Speaking generally, like the tiger, the panther does not attack man if unprovoked. If taken unawares a panther may attack in self-defence or turn on his pursuers as when wounded, or harried in a beat. The attack may be made in error, the panther mistaking man for more legitimate prey. This sometimes happens when people are moving or sitting in heavy cover. This chance killing of a man is suggested as one of the causes which lead panthers or tigers to man-eating. The diffidence to attack human beings once overcome may induce an individual to include human beings amongst its prey or may convert it into a habitual man-eater. While the confirmed man-eating panther is fortunately rare the number which occasionally take human food is not inconsiderable.

Failure in the accustomed food supply or in the ability to obtain it contributes to the making of a man-eater. One of the after results of the great famine in Gujerat between 1901-1903 was a marked increase in the number of man-eating tigers and panthers.

The village panther unable to obtain its usual food may take to man-killing. In the recorded case of one individual whose accustomed prey was dogs and cattle, the first victim was a baby, the second an old woman, and the third a boy. Emboldened with its success, such a panther first limiting itself to taking people asleep outside their huts, takes to entering huts, to carrying off people sitting up by a fire and finally to killing in broad daylight. Brought into more intimate touch with Man, the man-eating panther is not only more frequent than the man-eating tiger but more to be dreaded. Familiarity with Man and his ways makes it bolder, more difficult to circumvent and gives it greater capacity for destruction.

The Call of the Panther.

The commonest call of the panther is a succession of deep intakes of air and hoarse barking coughs—an interval of a second separating each respiratory effort. The call is made with the mouth partly open. The air inhaled and expelled through the trumpet-like cavity of the throat beats against the transverse ridges of the palate which, it is suggested, possibly play a part in increasing the sonority of the tone. The call is usually likened to sound produced by the thrust and return of a coarse-toothed saw cutting through thin wood. A pair of panther cubs in captivity gave vent to this distinctive sawing call when moved by the prospect of a meal or when separated from one another. The occasions when they used it may suggest a similar usage in the adults. Among other sounds made by panthers is the low deep threatening growl which is the preliminary intimation of a charge by a wounded or angry beast. The two or three deep coughs which may accompany the charge are very similar to the sounds made by a tiger in like circumstances. A soft purring 'gr-gr', at times hardly perceptible is occasionally emitted in the vicinity of a 'kill' and there is, as in the case of the tiger, the 'whoof' with which a panther expresses alarm and disapproval when surprised and rushing off.

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The Mating and Breeding of Panthers.

Panthers like tigers breed all the year round. Mating has been observed in various months of the year. It is a common belief that most animals have well demarcated breeding seasons. Critical investigation has shown that a relatively large number breed throughout the year. This is particularly true in the case of tropical animals. When a species has a demarcated breeding season it recurs rhythmically at the same time every year. The quiescent reproductive organs of the male become active while the female undergoes cycles of reproductive activity. As a general rule, the sexual periodicity of the male is the counterpart of the female's: but with some species the male season may begin earlier than the female or the male may remain reproductively potent throughout the year, while the female experiences cycles of sexual activity and quiescence. The reverse may also occur. We have no definite knowledge as regards sexual periodicity in the larger Felidae. We do not know whether the males are sexually potent throughout the year nor do we know anything about the cycles of sexual activity in the females. In a lioness in captivity periods of heat about a week in duration occurred at intervals of three weeks till the animal became pregnant. Whether similar condition obtain among the larger felines in the wild state remains to be discovered. Such information is extremely difficult to obtain particularly in relation to animals in the wild state. When animals are shot, microscopic examination in the field of the fresh contents of the reproductive organs in both may shed some light on the points raised. It cannot be doubted that a mass of interesting details remains to be discovered which would give us a clearer understanding of the breeding habits and social life of these animals.

The intervals at which panthers produce a litter in the wild state are not definitely known. A pair of panthers in captivity had three litters in 3½ years. That sexual activity in the female recurs shortly after the production of a litter is instanced in the case of a female accompanied by two cubs computed to be above two, but not more than 6 months old. The parent which was shot during the month of May was found to contain four foetuses. If the age of the cubs was correctly estimated and if we set their age at the estimated maximum of 6 months, then her cubs were born approximately in December. The period of gestation being 3 months, a second litter would have been produced approximately at the end of July. This gives an interval of nine months between the production of two litters. The case may or may not be exceptional but it points to a potentially high rate of breeding among panthers which is probably one of the reasons why the species maintains its numbers in spite of all the efforts to reduce them.

Having acquired a mate there is little reticence in the courting of the panther. The procreative instinct overcomes all accustomed considerations for silence and secrecy. Their mating is accompanied by noisy demonstrations, by snarling and spasmodic roarings and by intervals of play, of gamboling and chasing dictated by the

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receptive or resentive attitude of the female. Mating may continue even after pregnancy is well established. There is a record of a pair seen conabiting, the female when shot, was found to be bearing three foetuses about two weeks old. It is believed that the association of the male and female continues when the cubs are born. Whether it is ever permanent is not known. In the tiger it is believed that the association is interrupted at this stage. We have seen that among panthers sexual activity may recur shortly after a litter is produced. In these circumstances the male may be the original partner or a new-found mate. Mr. R. C. Morris has seen a family of 6 panthers consisting of an adult male and female, 2 three-quarter grown cubs and 2 cubs (about 2 months old). The adult male was possibly not the father of the larger cubs. That a female losing her mate will in favourable circumstances promptly take another is seen in the case of a panther acquiring a fresh partner twenty-four hours after the death of her previous mate.

The period of gestation is said to be about 12 weeks. Two to four cubs are usually produced. The mother chooses a cave, the hollow trunk of a tree, an overhanging rock or even a porcupine's earth as a shelter for her litter. She is assiduous in her care of them and is said to display greater determination in their defence than is usually seen in the tiger. Nothing precise is known about the period of lactation or when the cubs are weaned or how long they continue to live with their parents or when they attain maturity. Females accompanied by cubs almost as large as the parent have been frequently observed. From an early age the cubs display their predatory instincts, going through the process of crouching, stalking and springing at one another in the manner of the adult. As with the lions and tigers the mother is said to watch the early attempts of the young in making a kill. Col. Mosse records his observation of the behaviour of a female with a cub about as large as herself at a kill. The cub was all concentration while the mother affected complete indifference to the tethered bait and changed her position only to get a better view of the efforts of the cub. The conflict between the impatience of youth and the instinct for cautious approach was strikingly apparent in the efforts of the cub to stalk its quarry. The interesting *denouement* was unfortunately prevented by a shot from the observer.

The high rate of breeding among panthers has already been indicated. Apart from this, the panther's wide range of food and its powers of resistance to adverse influences of environment have endowed it with those attributes which make for survival and which enable it to maintain its being over the vast range of territory which it inhabits. Man's efforts at extermination have made but little impression on its numbers in this country. Though it has not the magnificence of the tiger nor the imposing presence of the lion, the panther typifies in itself all the distinctive attributes of the Great Cats. It exhibits in perfection that symmetry of form, that combination of grace, strength and agility which distinguish its tribe. The panther is the embodiment of the ideal of a beast of prey.

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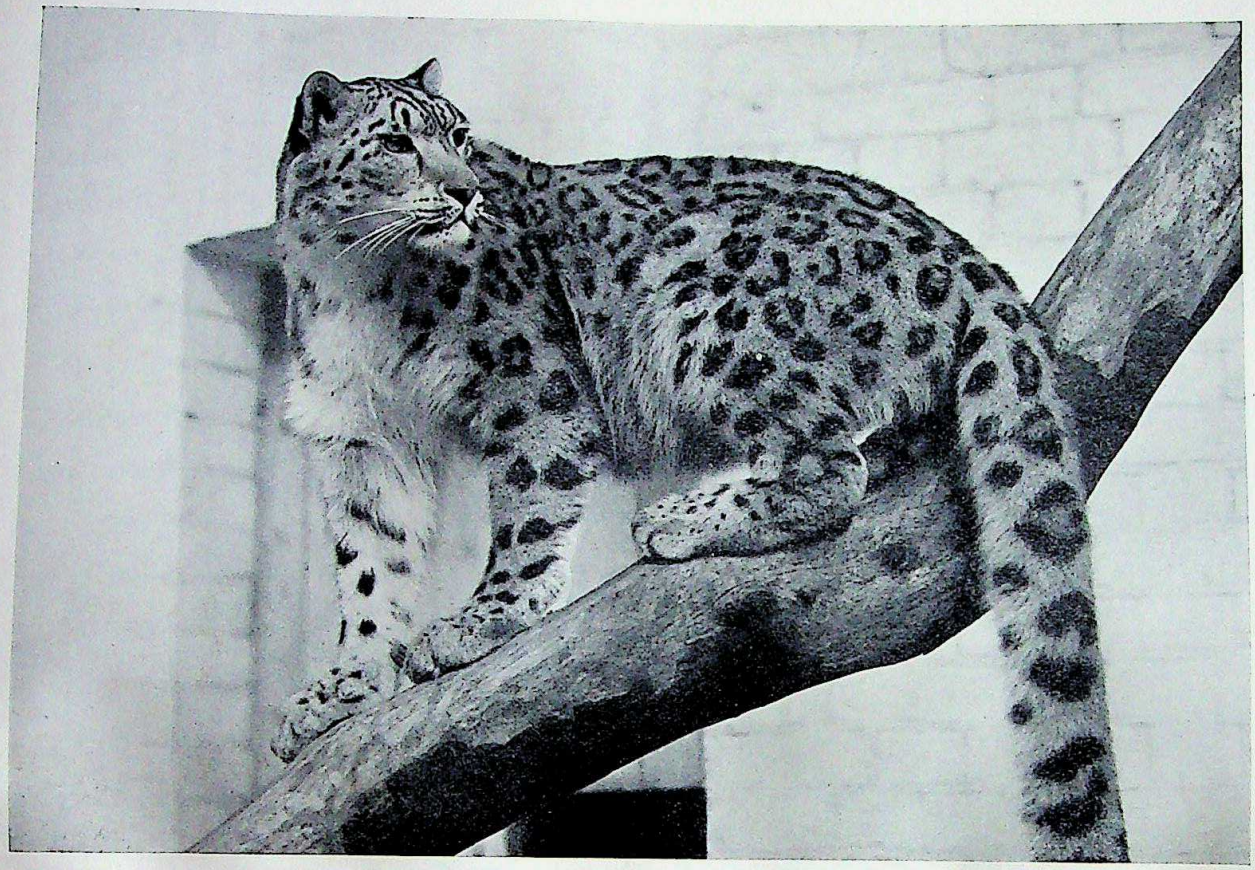

Photo by *F. W. Bond.*

The Snow Leopard (*Uncia uncia*, Schreber).

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THE SNOW LEOPARD OR OUNCE (*UNCIA UNCIA* SCHREBER).

The Snow Leopard is perhaps the most beautiful of all the cats. The soft colouring and luxuriant beauty of its fur, particularly in winter, is unrivalled. In common with all creatures to whom Nature has given a special endowment of beauty it pays the price in being persistently sought after and killed by Man.

The known range of the Snow Leopard is the high tablelands of Central Asia reaching northwards into the Altai Mountains and southwards to the Hindu Kush Mountains and the Great Himalayan Range.

An affinity between the Snow Leopard, the Lion, Tiger, Panther and Jaguar is deduced from a similarity in the structure of the hyoid apparatus in these animals. The Snow Leopard is placed in a separate genus because of peculiarities in the structure of its skull. Among the more obvious differences are the shortness of its muzzle, the elevation of the forehead and the vertical chin. A more fundamental distinction is seen in the structure of the auditory bullae—the bony swellings on the under surface of the skull, close to the ear openings. The auditory bulla of an Ounce is divided internally by a vertical partition into two nearly equal chambers. In the tiger, lion, panther and jaguar the chambers are unequal.

The ground colour of the Snow Leopard's coat is soft grey, paling to pure white on the underside. The spots are unbroken and distinct on the head, nape and lower parts of the limbs. On the body they break up into larger, paler rosettes. The rosettes are less distinctive in the more luxuriant fur of the winter coat; a black streak extends from the middle of the back to the root of the tail. Except for a few dark blotches the fur of the belly is pure white.

Little is known about the habits of the Snow Leopard. It is entirely nocturnal. During summer the animal lives in the higher altitudes of its range. It has been seen at a height of 18,000 ft. upwards. In this treeless region it preys on burhel, ibex and on marmots and other rodents, occasionally taking a calf or a sheep from the flocks grazing in the higher reaches during Summer. In Winter, Snow Leopards come down to the warmer valleys as low as 6,000 to 7,000 ft. where they find more frequent occasion to take domestic prey and offer better opportunity to be trapped or shot. Nothing is known about their breeding habits.

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Sub-Family II: *ACINONYCHINAE*.

THE CHEETAH OR HUNTING-LEOPARD (*ACINONYX JUBATUS* ERXLEBEN).

In India the Cheetah is all but extinct in the wild state. It once ranged from the confines of Bengal through the plains of the United Provinces, the Punjab and Rajputana, through Central India and the Deccan. It is not known to have occurred in South India and Ceylon. Evidence of its existence in recent years in some parts of its known range is seen in such records as the Society has been able to collect. A Cheetah was killed in 1918 and another in 1919 in the Mirzapur District of the United Provinces. Five Cheetahs are recorded as having been obtained in this Province during the previous twenty-five years. In the Central Provinces, the Cheetah appears to have been not uncommon at one time in the Berars. Three were shot in the Melghat Forest area in 1890 and one in 1894 and one at Wano in 1895. Rumours of their existence in parts of Berar, the Seoni Plateau and Saugor still persist. They were apparently once common around Hyderabad, Deccan. The only part of the Bombay Presidency where Cheetahs were known to occur recently is the tract of rugged country known as the Tanga in the centre of the province of Kathiawar. In 1884 it was estimated that there were not more than twenty of these animals in this area. A female and four cubs were shot at Rajkot in 1894.

Outside India, the range of the Cheetah is said to extend northwards to Russian Turkestan and Trans-Caspia. In South-Western Asia its range is believed to reach from the frontiers of Sind through parts of Afghanistan, Baluchistan and Persia and Mesopotamia to Syria and Palestine and thence into Africa, where cheetahs are, or were once found as far south as the Cape. To what extent it survives in these Asiatic countries is not known. There is a record of a female and cubs taken at Nasriyah in Mesopotamia in 1928, but the animal was not known to the local Arabs.

Certain peculiarities in the structure of a Cheetah differentiate it from all other cats. In size and form a Cheetah looks like a long-legged slender-bodied leopard. But its slimness of body and length of limb are equalled by some cats such as the African Serval. Its head is rounded and relatively smaller than in any other form of cat—the facial region and particularly the cranium slopes steeply downwards and gives its skull a dome-like shape.

The Cheetah's most distinctive character is the structure of its feet. Its claws are usually described as non-retractile. The claws of cats are retracted and raised from the ground by elastic ligaments which pull on the terminal joints of the toes. Now the claws of a cheetah are approximately if not quite as retractile as in some species of cats. Their distinctiveness lies in this that the claws of cats are covered in varying degrees by sheaths of skin, while the claws of a cheetah are always bared owing to the entire absence of skin sheaths.

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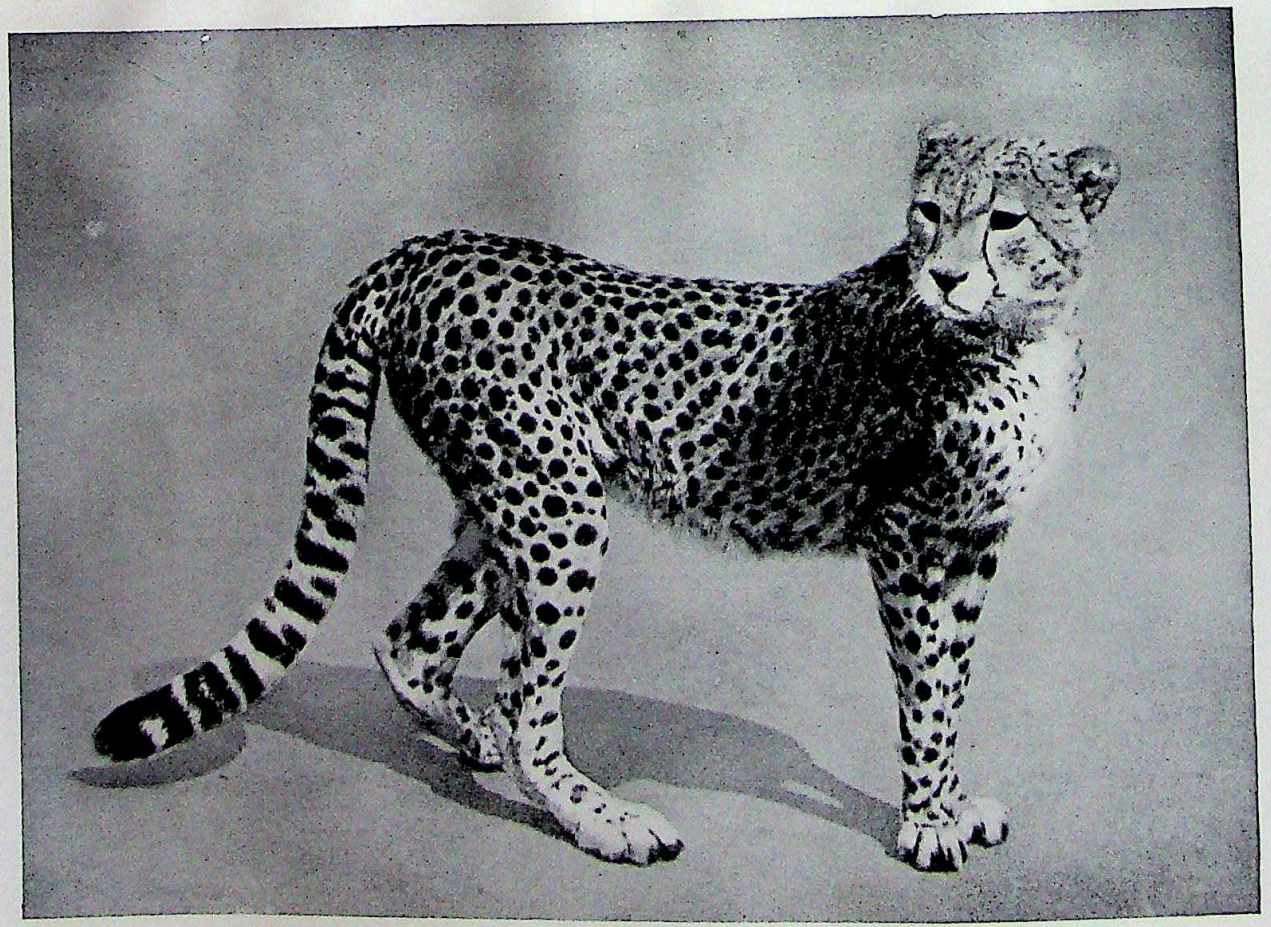

Photo by *F. W. Bond.*

The Cheetah or Hunting Leopard (*Acinonyx jubatus*, Erxleben).

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The colour of an adult cheetah varies from tawny to a bright rufous fawn. Its coat is pale below and spotted almost everywhere with small round solid black spots. The chin and throat are buffy white, a black line runs from the corner of each eye to the upper lip, and there is a less distinct line or row of spots from the corner of the eye to below the ear. The fur is coarse; the lengthening of the hair on the neck suggests an incipient mane. A pair of cubs taken in the Berars are described as having long grey silky hair, without spots, covering the head and back and reaching half way down the flanks, giving the cub an appearance of wearing a great coat. The remainder of the body was covered with short grey hair sprinkled with single black spots. A cub taken in Nasiryah in Mesopotamia is described as being fawn-coloured—the hair on the upper part of the body was 2-3 in. long and unspotted; while the limbs and lower part of the body showed a sprinkling of dark spots. The head and body of a cheetah measures about 4-5 ft., the tail 2-5 ft., its height is from 2 ft. to 2 ft. 9 in.

We know little about the habits of the Cheetah in the wild state. In India it is usually found in low rugged hill country bordering the plains; near Hyderabad it is stated to live in holes in rocks or among accumulations of rocks and boulders. It preys on antelope, gazelle and nilgai and such creatures as it can master. One was shot in the U.P. while stalking a sambhar. Unlike other cats, speed and not stealth of movement is the essence of the Cheetah's hunting. All those characters which distinguish the Cheetah from other cats have arisen from its distinctive method of pursuing its prey. The small head, narrow chest and body, long sinewy limbs, and powerful hind quarters are designed for speed; while its protruding claws, hard, pointed pads and larger hind feet are well-fitted for securing a firm hold on hard or sandy ground. Crouching low, a cheetah takes advantage of every inch of cover or unequality in the ground till it gets within a distance to make its rush upon its quarry. While it lacks the elasticity of gait and the suppleness of body so distinctive in the cats, not the fastest antelope can equal a cheetah's initial speed. Coming up with its fleeing quarry, the Cheetah fells it by striking its hind legs from under it. The animal falls and is then seized by the throat. This manoeuvre of tripping up its prey was constantly observed in the play of a pair of cheetah cubs. The pursuer going at full speed always attempted to upset its mate by striking at the hind legs and having felled it, made for and worried it at the throat. Failing to seize its prey in its initial rush the Cheetah appears to have no reserve of strength or breath and usually gives up the chase.

Nothing is known of the breeding habits of the Cheetah in India. There is a record of female with 4 cubs which was shot near Rajkot in Central India. The mother and one cub were away when the other cubs were discovered under a bush. A pair of cubs a week old were taken in the Berars in December.

The Cheetah has been for centuries the playing thing of princes, Asiatic, African and European. When taken young it is easily tamed and trained to show its wonderful speed. A couple

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of cheetahs were sent as a present to Anastasius, Emperor of the East, at Constantinople in A.D. 439 from whence the sport reached Italy and obtained an enormous vogue among the wealthy, extravagant grandees of the great City States. The Turks, Moors and Persians alike used cheetahs in hunting. In India the Cheetah is usually taken blind-folded in a cart to the scene of the hunt. In the proximity of a herd of antelope it is unhooded and slipped from its leash: a short crouching stalk and a few bounds of great length and rapidity and the hunt is over—the quarry has escaped or the Cheetah holds it in a strangle-hold by the throat, till the keeper comes up and having cut the captive's throat rewards the captor with a drink of warm blood collected in its accustomed feeding bowl.

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Sub-family III: *FELINAE*: TYPICAL CATS.

We have dealt with two groups of the Cat tribe, one, the *Acinonychinae*, included the Hunting Leopards, differentiated from all other cats by the absence of protective sheaths to their claws, and the other, the *Pantherinae*, comprising the Lion, Tiger, Jaguar, Leopard and Ounce, distinguished in their anatomy by the peculiar attachment of the hyoid apparatus to the cranium. It has been explained that in these Great Cats the supporting arms of the apparatus is composed partly of elastic ligament which gives greater mobility to the larynx and has its influence on the voice of these animals. The typical cats including all the smaller and medium sized forms are grouped in a third division of the tribe: the *Felinae*. In all these species the hyoid apparatus is normal. Its arms are formed of an uninterrupted chain of small bones which hold the larynx close up to the skull and restrict its movements. From this distinction in the structure of the hyoid apparatus arises those differences in the character and sonority of the voice between the great and in the lesser cats. The smaller species do not roar in the manner of lions, tigers or leopards. Apart from the roar, there is another distinctive feature about the voice of those cats in which the hyoid apparatus is normal. This is the familiar 'purr'. The great cats never purr—on the other hand, widely different species like cheetahs, pumas, lynxes and the various forms of smaller cats express pleasure and contentment by that sound.

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No. 7. THE JUNGLE CAT (*FELIS CHAUS* GULD.).

The Jungle Cat has a wide distribution ranging from North Africa through Western Asia into India and Ceylon, Burma and China. The typical form of this cat, *Felis chaus chaus*, is found in the Caspian area from whence the species was originally recorded and described. Over its extensive range, 3 or 4 races of the Chaus are distinguished. The race found in India, Burma and Ceylon is known as *Felis chaus affinis*. It is said to differ from the Jungle Cats of Egypt, Palestine and the Caspian by its relatively longer tail, bright foxy red ears and slighter build. Its skull is narrower and the teeth less strongly developed. Some of the Jungle Cats from the reed beds of the River Tigris in Mesopotamia were indistinguishable from the Indian race, others approached the African form.

The Jungle Cat, the common wild cat of India, is found practically all over the Peninsula from the Himalayas to Cape Comorin. It is commoner in the drier parts of the country keeping more to grass-land and scrub-jungle and the reedy banks of rivers. In Ceylon and Burma it is again more common in the drier zones.

With its long legs and comparatively short tail—the Jungle Cat has a very distinctive appearance. Its pale green eyes give it a coldly cruel expression. The colour of its fur varies from sandy grey to yellowish grey. The tail is ringed with black towards the end and has a black tip. The paws are pale yellowish; black or sooty brown underneath. The ears are reddish, ending in a small pencil of black hairs. The underside of the body is paler with vestiges of stripes on the underside and flanks. Head and body about 2 ft. in length; tail 9 in. Weight anything from 8 to 25 lbs.

The Jungle Cat is frequently about by day—more usually in the mornings and evenings. Its movements in the open are much like those of a small panther. It preys on small mammals, birds and, when near villages, on poultry, making bold to seize its prey even in the presence of the owners. Very swift and exceedingly strong for its size, it is quite capable of bringing down larger game. Crump, writing of these cats in Kumaon says that it was not at all uncommon to find the quills of porcupines which they had killed or attempted to kill embedded in their paws.

Little definite is known about its breeding habits. Blanford states that it has two litters in a year. The kittens are easily tamed and purr like a domestic cat when pleased. They resent the approach of strangers and remain amusingly savage at feeding time.

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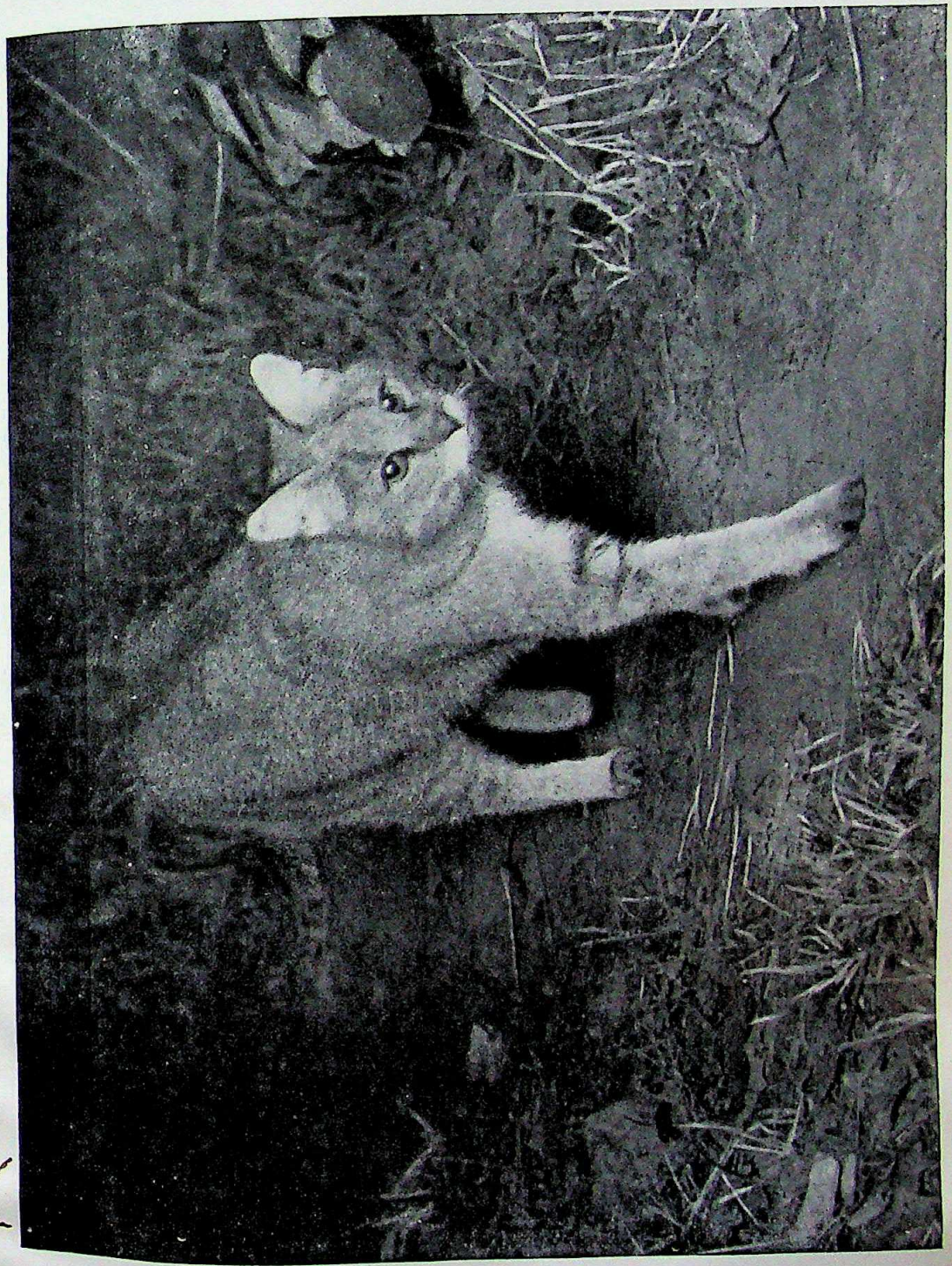

The Indian Jungle Cat (*Felis chaus affinis*, Güld).

F. W. *Champion.*

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THE DESERT CAT (*FELIS ORNATA* GRAY).

The Desert Cat is found in the desert wastes and sand hills of Sind, Cutch, Rajputana, from whence its range extends to the more arid portions of the Punjab, Kathiawar and the eastern parts of the Central Provinces.

From the structure of its skull and teeth as well as from other characters, it is deduced that our Desert Cat is the Indian representative of a group of cats, typified in Africa by the African Wild Cat, *Felis ocreata*, and in Europe by the European Wild Cat, *Felis sylvestris*. Incidentally it is interesting to mention the theory proposed by Pocock that the domestic cats found about houses and villages in India—of which there are two types, one spotted or streaked, the other uniformly grey or yellowish grey have been derived from the African Wild Cat, *Felis ocreata*, either by the introduction of tamed animals or by the reclaiming from the wild state of examples of this species which may have inhabited India in comparatively recent times. Mr. Pocock can find no evidence to support the older theory that our domestic cats have originated from indigenous Indian species such as the Chaus (*Felis chaus*) the common Jungle Cat of India, the Leopard Cat, or the Rusty Spotted Cat. It would be interesting to have authentic evidence of the inter-breeding of wild and domestic cats in India. On the other hand various so-called species of wild cats from India such as the Waved Cat (*Felis torquata*) from Nepal and Kashmir, *Felis inconspicua* from Rajputana, and *Felis huttoni* from Afghanistan are believed by Pocock to have arisen as a result of the description by different naturalists of the various colour forms of the European Wild Cat, *Felis sylvestris*, which is found in a feral state in many tropical countries.

Not much larger than a domestic cat, the Indian Desert Cat has pale yellowish fur more or less infused with grey and marked with numerous black spots. The terminal half of its tail is ringed with black. It has two horizontal stripes on its cheeks, numerous dark cross lines on the outside of the limbs and the usual two distinct black bars on the inner side of each fore-arm. The chin, throat and breast are white and unspotted. The ears are coloured like the back, with a few black hairs at the tips. It inhabits sandy plain and hills, where it preys on birds and rodents. One was killed while feeding on the carcase of a sheep. Nothing is known of its breeding habits.

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THE LYNX (*LYNX LYNX* LIN.) AND THE CARACAL (*LYNX CARACAL* GULD.).

The genus Lynx includes three distinct groups of animals—the typical Lynx (*Lynx*) and its various species and races inhabiting the boreal region of North America and the cold and temperate regions of Europe and Asia, as far south as the Mediterranean and the Western Himalayas. Secondly, there are the Lynxes of the temperate region of America which range as far south as Mexico and lastly, the Caracals (*Lynx caracal*) which inhabit South-Western Asia and the greater part of Africa.

The true Lynx which occurs within our limits in the upper Indus Valley, in Gilgit, Ladak and Tibet is probably a race of the ordinary lynx of Northern Europe and Asia—distinctive in its pale sandy grey or isabelline colouring—hence its name *Lynx lynx isabellina*. It is strongly built cat of medium size with a short tail, broad head, large triangular tufted ears. Its paws are large, the claws well-sheathed, and the pads more or less concealed by hair. Its face is framed with a partial pendant ruff of long hair. In summer, its coat shows a sprinkling of spots which may persist, but usually disappear in the heavier winter coat, except on the limbs and flanks. The Lynx is a creature of high altitudes where it preys upon birds and such animals as it can kill from rodents to sheep and goats. Writers have commented upon its wild and fierce disposition. Its keen eye-sight and hearing are proverbial. Rarely seen—little is known of its habits. It is said to have 2 or 3 young—the mother usually hiding her litter in a cave or in a hole among rocks.

The Caracal (*Lynx caracal*) known as the *Siyah gosh* or 'black-eared one', is found in Sind and Cutch and is said to be common in the North and North-West Hills of the Cutch State. It is found in the drier parts of the Punjab, Rajputana, the United Provinces and Central India. Outside our limits its range extends into Persia, Mesopotamia and Arabia and over the greater part of Africa.

The Caracal has the broad head and tufted ears of a true lynx. Like the Lynx it stands higher in the hind limbs than on the fore, but it is smaller and lighter in build and has a longer tail. Its skull bears a general resemblance to that of a lynx, but is narrower in the cranial and facial portions and recalls in some of its structural characters the skull of a typical cat (*Felis*). Its coat though not as dense as that of the Lynx is yet thick and soft. The colouring is a uniform reddish grey above fading into buff or white below. Faint indications of spots are present on the under surface and sometimes on the back.

An uncommon and elusive animal, little is known about the caracal in the wild state. It is a creature of desert and scrub jungle, where it preys on birds, which it is said to take in flight by springing up at them, on rodents, antelope and small deer. There is a record of a caracal attacking a man in the Mirzapur District, U.P., but it is believed that the animal was driven to the

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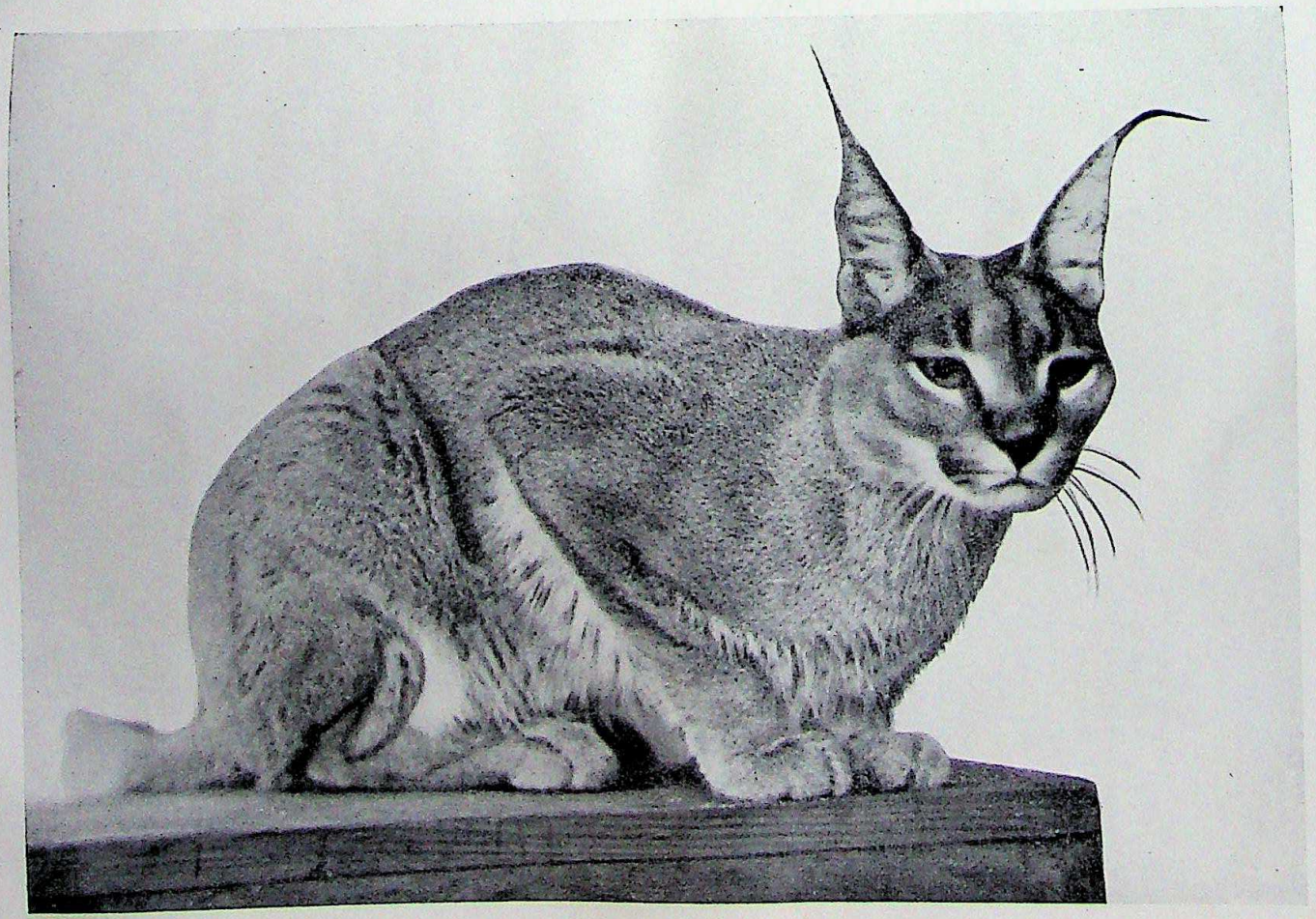

Photo by *W. S. Berridge.*

The Caracal (*Lynx caracal*, Güldenstadt).

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act by hunger—it was in a very emaciated condition—or, that it made the attack in error. A captive caracal in the Mysore Zoo killed and partly ate a large cobra which had entered its cage.

Like the Cheetah, it is easily tamed and trained to show its prowess in hunting small deer, gazelle, hares and foxes and also birds such as peafowl, crane and pigeon. It relies for success upon its extraordinary agility. So perfect is the sympathy of eyes and feet, that champion performers in this sport, still popular in Persia, will kill 9 or 10 of a flock of feeding pigeons before they can leave the ground. It is interesting to note that of all the species of cats the Caracal comes nearest to the Hunting Leopard in the structure of its hind feet. It is trained to hunt in much the same way as a Cheetah, whose wide hind feet are better-fitted for securing a firm hold upon sandy ground and for traversing it more swiftly and surely than are the softer more pliable feet of other members of the cat tribe.

Nothing definite is known about the breeding habits of the animal in India. It is said to rear its young in porcupine burrows, in hollow trees or crevices among rocks—the average litter being 2-4.

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PALLAS'S CAT (*TRICHAELURUS MANUL* PALL.).

Pallas's Cat is a Central Asian species. Three forms of this cat are known—the typical race is from Turkestan and Western Siberia, a second is found in Mongolia and Siberia east of Lake Baikal and the third known as *Trichaelurus manul nigripectus* Hodgs. occurs within our limits in Ladak and Tibet. Though distinguished by a number of structural peculiarities, Pallas's Cat holds in some aspects a position intermediate between the Lynxes and the true cats (*Felis*).

It is a small, long-tailed cat with a broad head, low forehead and short widely-separated ears, which appear to be set very low behind the cheeks and give the cat a strange and peculiar aspect.

Observation of the behaviour of a specimen in captivity suggested an explanation of its low forehead and the peculiar set of its ears. When watching its prey behind some rock or point of vantage—this species need not lower its ears in the accustomed manner of cats. It is able to reveal a relatively small part of its head without depressing or partially folding its ears—a habit which must to a certain extent interfere with quick hearing in other species.

The prevailing colour of the face of this cat is grey, that of the neck, back and body silvery or iron grey. The hairs on the back are sooty black at the base, then white, and again black at the tip. Traces of dark transverse stripes appear on the loins and sometimes on the limbs. The distal portion of the tail is ringed and ends in a black tip. The fur of the throat, chest, belly and thighs is considerably longer than on the flanks. It is perhaps an adaptation, which gives protection to the cat when lying or sleeping on snow-covered or frozen ground. A parallel lengthening of the hairs on the thighs and under parts of the body is seen in the Yak which, like Pallas's Cat, is a denizen of the bleak uplands of Ladak and Tibet.

Nothing is known about the habits of this cat in the wild state. It is said to live among rocks and to prey on small animals and birds. In captivity, its behaviour was distinctive from that usual in most other small felines. It showed no fear of spectators or a desire to avoid them and was very silent never uttering the familiar snarling growl or hiss. Its mew is described as recalling a 'combination of the bark of a small dog and the hoot of an owl'.

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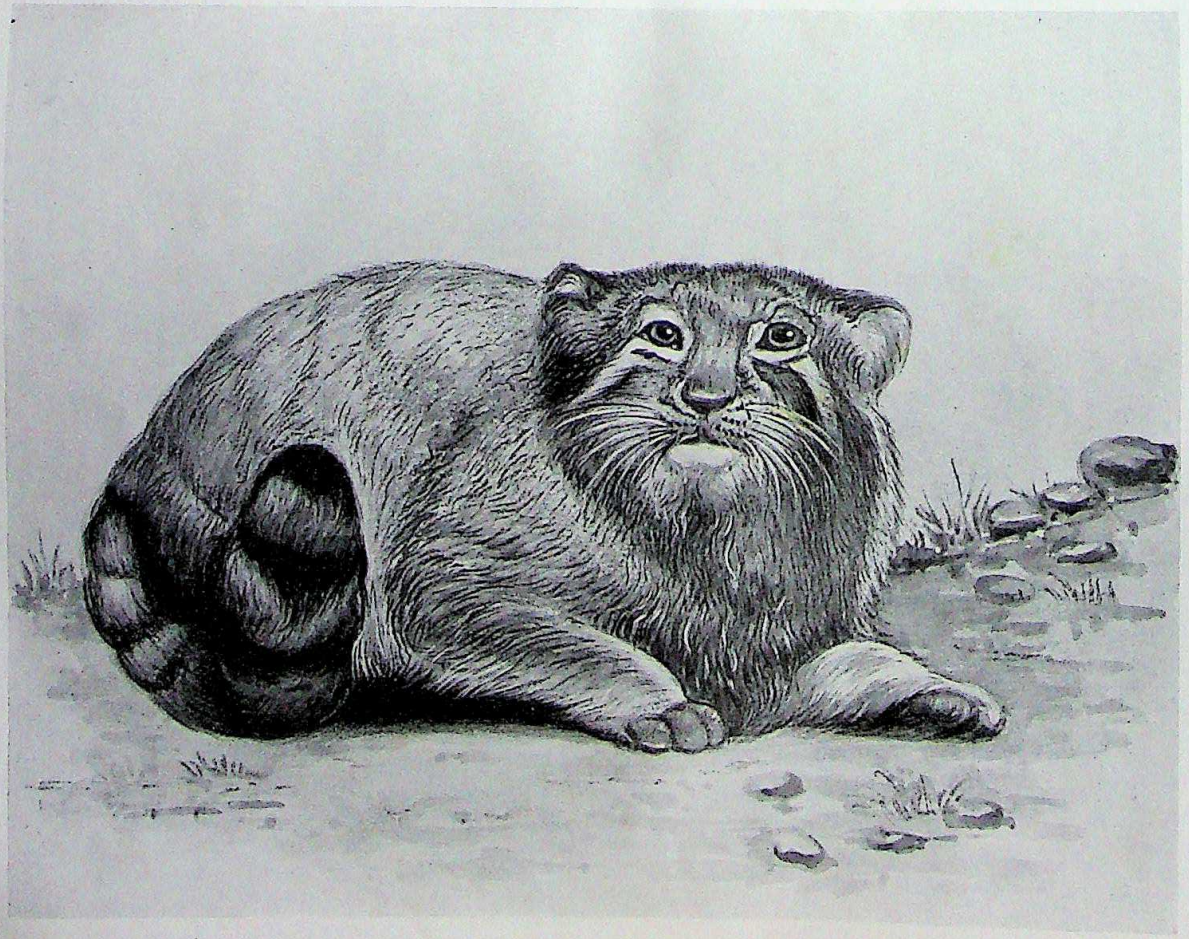

Pallas's Cat (*Trichaelurus manul*, Pall.)

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The Leopard Cat (*Prionailurus bengalensis*, Kerr.)

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THE LEOPARD CAT (*PRIONAILURUS BENGALENSIS* KERR): THE RUSTY-SPOTTED CAT (*PRIONAILURUS RUBIGINOSUS* GEOFFR.).

The Leopard Cat was originally described from a specimen which swam on board ship in Calcutta—hence its traditional name *bengalensis*. It is found in evergreen and mixed forests practically all over India—in the Himalayas, the Eastern and Western Ghats and in South India. It is recorded from Kashmir and South Baluchistan. Eastwards from Assam its range extends through Burma and Southern China into the Malay countries.

Rounded black ears marked with a white patch on the outer surface distinguish both the Leopard Cat and the Rusty-Spotted Cat from other cats of the genus *Felis*. The Leopard Cat is about the size of a domestic cat but rather longer in the leg. Its colour and markings give it the aspect of a miniature panther. The prevailing colour of the body is yellowish above, white below, ornamented throughout with black or brownish spots. Both colour and pattern are very variable in the species, the ground colour may show a tendency to grey or rufous and the spots, usually arranged to form regular lines along the body, may coalesce into uninterrupted longitudinal bands. Among other markings are four more or less distinct bands running from the crown over the neck, which break up into short bars and elongate spots on the shoulders. There is a pair of horizontal cheek stripes, the lower joining a black bar across the throat and the usual two black bars on the inside of the fore-arm. The spots on the tail form cross bars towards its end.

This beautiful forest cat preys upon small birds and animals. It is nocturnal in habit and seldom seen. The Society's collectors found it common about villages in Coorg where it is said to be very destructive to poultry. It has 3 or 4 cubs in a litter. A kitten a month old was taken in August in the Niligiris. It became quite tame and though driven off by domestic cats returned more than once to its owners after a sojourn in the forest.

The Rusty-Spotted Cat (*Prionailurus rubiginosus*) is about half or three-quarters of the size of a domestic cat. It is a slightly built active creature with a soft, smooth, fawn grey coat, patterned with brown bars and spots arranged in more or less regular lines. The markings on its head and shoulders are dark brown; they change to rusty on the flanks and are reduced to smaller round spots on the hind quarters. The underparts are nearly white with black spots. Length of body nearly 17 in., tail half the length of the body, weight about 3 lbs. It is found in Southern India and is recorded from the hill forests of the Western Ghats at Khandala in the Poona District, and from Seoni in the Central Provinces. It is common in jungles over the whole island of Ceylon. This elegant and agile little cat lives both in forest and grasslands—in

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Ceylon it is rarely seen away from jungle. It shelters by day in holes in trees or under bushes, and hunts by night preying upon small birds and mammals or on poultry, when living near villages. The female has a litter of 2-3 young and conceals them in a hollow log or tree.

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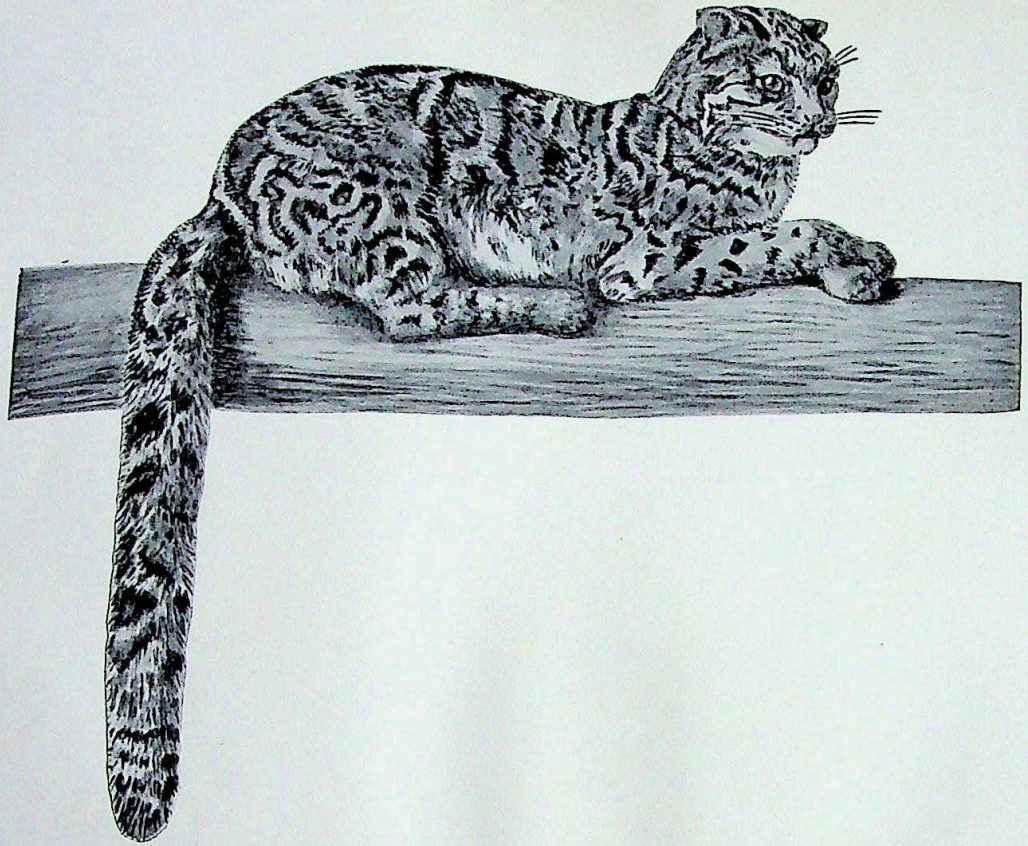

del. O. F. Tassart.

The Marbled Cat (*Pardofelis marmorata*, Martin).

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THE MARBLED CAT (*PARDOFELIS MARMORATA* MARTIN).

This beautiful cat, one of the rarest of all its tribe in museum collections is found in the forests of the Eastern Himalayas and Assam from whence its range extends into Burma and the Malay countries. As a genus, the Marbled Cats are distinguished from the Leopard Cats and their oriental relatives by structural peculiarities of the skull which among other points of distinction is short and broad, more rounded and has wider cheek arches. The teeth especially the canines are relatively more robust and the chin more vertical.

Three races or forms of this cat are known. The East Himalayan race, described under the name *Pardofelis marmorata charltoni* from a specimen taken at Darjeeling, is found in Sikkim and Assam. How far this particular race extends into Burma is not known. The Himalayan Marbled Cat is said to be quite distinctive in its thicker, longer, rich ochreous brown coat whose luxuriance tends to obscure the 'marbled' pattern more apparent in typical examples from Java and Sumatra.

The general pattern on the coat of these cats consists of stripes on the crown, neck and back, of large and small blotches, making the so-called 'marbling' on the flanks and of spots on the underside of the limbs and on the tail. The marbled pattern on the flanks is variable even in cats inhabiting the same region. In the Himalayan race, it is limited to a few, wavy greyish buff stripes which break up the ground colour of the flanks into large ochreous brown patches. The heavily spotted legs are of the same rich hue as the body. The tail is darker in tone and its pattern is obscurely defined. Though much smaller in size, the Marbled Cat resembles the Clouded Leopard in colour and pattern so that young Clouded Leopards are easily confused with this species.

Nothing is known about the habits of this cat. It is conjectured that it is a purely forest cat of arboreal habit. A supposition supported by the structure of its feet which show no adaptation to ground dwelling habits. Its tree climbing and nocturnal habits are suggested as a reason for its rarity in most collections.

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THE GOLDEN CAT (*PROFELIS TEMMINCKI* VIG.).

With the exception of the Clouded Leopard, the Golden Cat is the largest of the group of smaller Oriental felines (*Felinae*). It is a fine sturdily-built cat reaching nearly 5 ft. in length. The typical form of this cat (*Profelis temmincki temmincki*), distinctive in the shortness and sleekness of its coat and the absence of body markings, comes from Sumatra—from whence its range extends into the Malay Peninsula, Indo-China, Siam, Burma, Assam and the Eastern Himalayas. Golden Cats inhabiting more northern latitudes in South-Eastern Tibet, Southern and Western China are said to be distinguished by a greater luxuriance of fur; while one form from the interior of China is distinguishable by its pronounced body markings, which form bold lines and large rosettes.

The general colour of the typical Golden Cat varies from golden brown to dark brown, bright red and grey. Black examples are also known. There is usually little or no trace of pattern on the body, when the coat is short and smooth there may be a more or less distinct pattern of greyish lines on the flanks and shoulders. It is suggested that the uniform colouring of the animal without markings is a result of the enlargement and subsequent fusion of blotches and the obliteration of the paler interspaces. Kittens have longer and thicker coats than the adults but show no pattern. But whether the body pattern in the adult is retained or lost, it is always conspicuous on the face of this cat giving it a very striking aspect. Most conspicuous is a horizontal white or buff cheek stripe, sometimes edged with black running from below the eye to behind the gape. On the inner side of the eye there is always a whitish stripe which bifurcates above and is continuous with a more or less distinct greyish stripe passing on to the crown. Occasionally there are curved lines running back from above the eye to between the ears.

Nothing definite is known about the habits of this cat. The Mishmis say that it breeds in hollow trees and has two young. The Lushai hunters state that it lives among rocks and does not climb trees. There is however a record of one which took refuge in a tree from a dog. It did not display the fierceness usually ascribed to this species, which in Burma is known as *Kya Min*, signifying that it dominates other cats even tigers!

The Golden Cat preys on poultry, sheep and goats and small deer. One was shot near Maymyo on a calf that it had killed; another was speared at Victoria Point, Mergui, after killing a buffalo calf.

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The Golden Cat (*Profelis temmincki*, Vig.)

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The Fishing-Cat (*Prionailurus viverrinus*, Bennett).

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THE FISHING CAT (*PRIONAILURUS* OR *ZIBETHAILURUS VIVERRINUS* BENNETT).

The Fishing Cat inhabits forest and swamps at the base of the Himalayas as far west as Nepal. It is found in parts of Bengal, the United Provinces and Sind. It is unknown from the Peninsula of India except in the creeks and backwaters of the Malabar Coast between Mangalore and Cape Comorin. It is found sparingly in the jungles of Ceylon, except perhaps in the dry Northern Zone—in the wetter parts of Burma and Tenasserim, in Southern China and Formosa.

The body of a large fishing cat measures about 2 ft. 6 in. and its tail is about a foot in length. It scales nearly 25 lbs. Short in limb and rather stout in build, its body is covered with short coarse, earthy grey fur, infused with brown. The body markings consist of a series of elongate spots arranged in more or less longitudinal rows. They vary in size and sharpness of definition in individuals. From 6 to 8 dark lines run from the forehead over the crown on to the neck breaking up into shorter bars and spots on the shoulders. The cheeks are greyish white with two usually well-defined horizontal black or brown stripes. Markings on the limbs are indistinct or wanting. The two usual dark bars appear on the inside of the fore-arm. The lower parts of the body are spotted and the tail is more or less distinctly ringed with black.

The Fishing Cat lives in heavy jungle, or in scrub, frequently in grass swamps or in reed beds, about rivers and tidal creeks. It preys on any animal and bird that it can secure and has been known to kill calves and sheep, to carry off dogs and even children. There is the record of a newly-caught male which killed a leopardess twice its size after breaking through the partition which separated their cages. It is given to feeding on fish and fresh water molluscs. Its method of fishing is to crouch on a rock or overhanging bank and to scoop up the fish with a blow of its paw. It does not enter the water in pursuit of its prey. The fore-feet of this cat have moderately well-developed webs between the toes, the claw sheaths are not large enough to completely envelope the retracted claws, the ends of which project considerably beyond the sheaths.

Nothing is known about the breeding habits of this cat. A single kitten was taken from a lair consisting of a beaten down patch among reeds with runs leading to it from opposite sides.

The Fishing-Cat (*Prionailurus viverrinus*, Bennett).

F. W. Champion.

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THE CLOUDED LEOPARD (*NEOFELIS NEBULOSA* GRIFFITH).

The Clouded Leopard is found in the forests of Sikkim, Bhutan, in Assam, in the dense evergreen forests in the extreme north and south of Burma, in Siam, the Malay Peninsula and Borneo.

The size of a Clouded Leopard is that of a small panther. A large male measured 6½ ft.; 3 ft. of which consisted of tail. The animal has a long body and tail and short limbs and rounded black ears relieved by a greyish patch in the centre. The structure of its feet is much like that of the panther and its near relatives, the tiger and lion. From the panther it differs in the structure of the hyoid apparatus and in peculiarities in the structure of the skull and the set of the teeth. Very striking is the Clouded Leopard in the enormous relative development of the upper canine teeth, which present the nearest approach among living cats to the great tusks of the extinct sabre-toothed tiger.

The markings of the Clouded Leopard give it a beauty and distinction equalled by a few of its tribe. The general colour of the body varies from grey or earthy brown to pale or rich yellowish brown fading to white or pale tawny on the under-parts. The face is marked with the usual cheek stripes so common in the smaller cats, and the head is spotted. Two broad bands, with narrower bands or elongate spots between them run from between the ears to the shoulders and extend more or less regularly in the form of large oval or elongate marks on the back. The clouded pattern of the flanks is formed by dark blotches more or less lined with black and divided by paler interspaces. The limbs and under-parts are marked with large spots and the tail ornamented with rings frequently imperfect on the sides.

Little is recorded about the habits of this beautiful animal. It is said to be strictly arboreal in habit and to prey on animals and birds after the manner of its kind. There is a record of one which was killed while advancing to attack a herd boy who split its skull with his *dah*.

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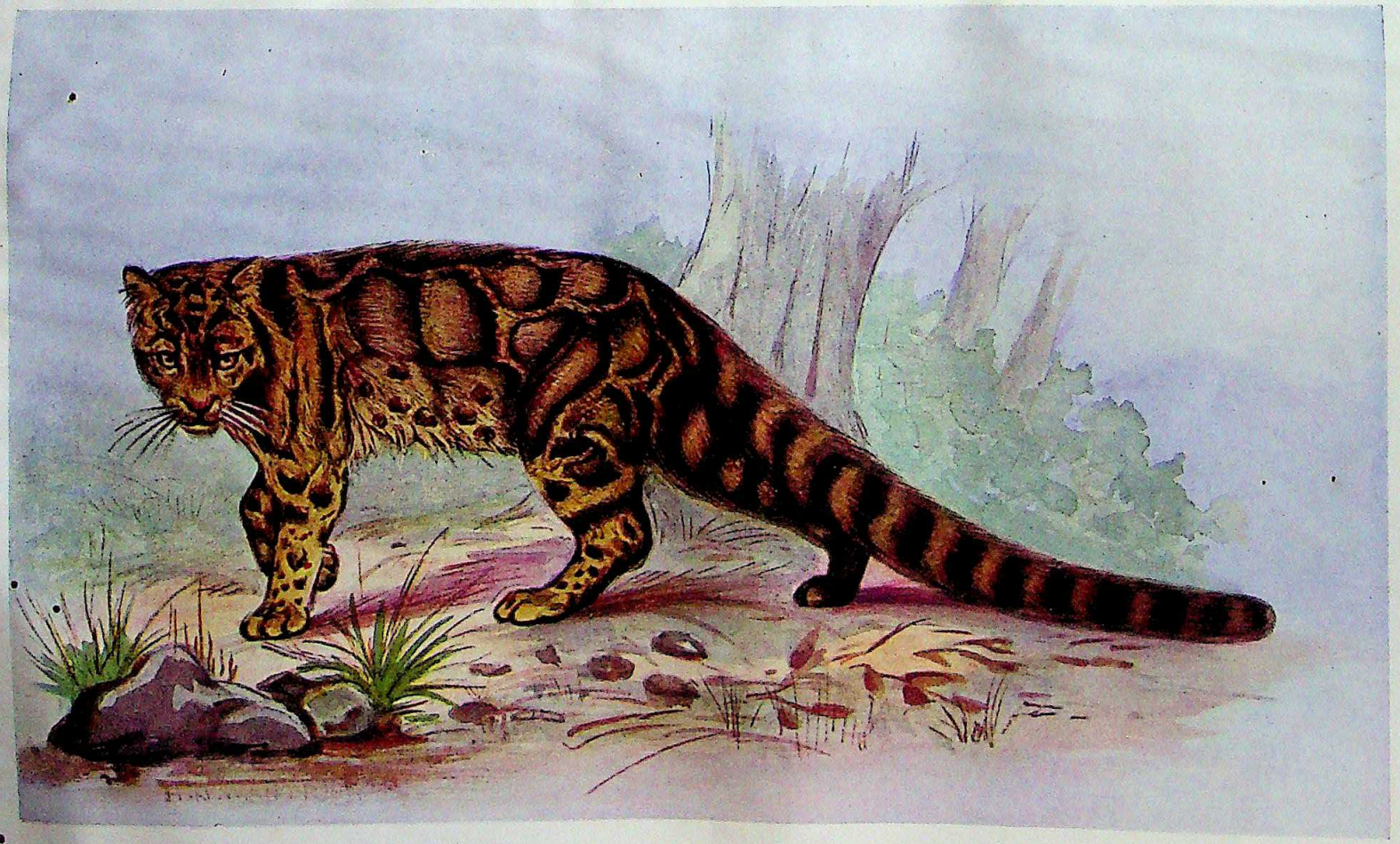

The Clouded Leopard (*Neofelis nebulosa*, Griffith.)

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THE PRESERVATION OF WILD LIFE IN INDIA.

No. 5. THE INDIAN LION.

BY

SIR PATRICK CADELL, KT., C.S.I., C.I.E.

I have been asked by the Honorary Secretary of the Bombay Natural History Society to write a note upon the Indian Lion, and the measures needed for his preservation. I gladly do so because I believe that there is no other wild animal in India which could so easily become totally extinct. It is now preserved solely by the efforts of one State. Should that State for any reason become weary of well doing, the lion would disappear from India in two or three years.

It is not necessary to write at length upon the history of the Indian lion. Two excellent articles on the Kathiawar Lion, written by Lieut.-Colonel Fenton, will be found in the Society's *Journal* of April 1909 and January 1911, and a chapter on the Indian Lion, which summarises most of the available knowledge, may be read in Brigadier General R. G. Burton's *Book of the Tiger*. It is sufficient to say that the lion was once widely distributed over India. Less than one hundred years ago it was common round about Delhi, and it was not very uncommon in Central India and Guzerat not more than seventy years ago. At about the same period it was to be found in the Barda Hills of Jamnagar and Porbandar, while it remained in the Girnar Range near Junagadh City till 1879. Now, however, the lion is entirely confined to the Gir Forest of the Junagadh State. That forest does not extend to 1,500 square miles, as Colonel Fenton says, but to 494 square miles only. The former figure once correctly represented its dimensions, and the late Maharaja Jam Saheb Ranjitsinhji, who spent a good deal of his boyhood within the limits of Junagadh, told me that he had then heard of lions in areas now distant from the forest. The spread of cultivation has very seriously encroached upon the forest and if this encroachment has now been stopped, it has largely been for the sake of the lions. Every one will agree that five hundred square miles is not a great area for the preservation of a species, and, alas, it has not proved to be large enough to prevent the animals straying into other jurisdictions where they have been of late years somewhat ruthlessly shot down.

It should be noted that it has long been recognised that the lion would disappear without preservation, and that it was believed that even with such preservation its extinction could only be postponed. Colonel J. W. Watson, an excellent observer and shikari, when writing the statistical account of Junagadh for the Bombay District Gazetteer about 1880, stated that 'there are probably not more than ten or a dozen lions and lionesses left in the whole Gir Forest', and this in spite of the statement that 'these are

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strictly preserved'. When Lord Curzon proposed to visit the Gir to shoot a lion, a well known Bombay citizen, who happened to be visiting Junagadh, wrote to a Bombay paper pointing out that there were supposed to be less than a dozen animals surviving. Immediately Lord Curzon was informed of this, he cancelled his shoot, and advised the Junagadh Darbar to preserve the animals strictly. Colonel Fenton writing in November 1908 states that the preservation was not very strict and that the animal was 'slowly but surely approaching extinction' and again that it was 'fast disappearing'.

It was, I believe, entirely owing to the fact that there was a British Administration in the State from 1911 to 1920 with a much stricter preservation of the lion and a considerable amount of co-operation for the time being from neighbouring jurisdictions that the lion has survived, and to some extent increased in numbers.

One of the dangers of the extinction of the lion lies in the comparative ease with which it is shot, and its lack of cunning and finesse as compared with the tiger or the panther. Before I explain the circumstances which make it easy to shoot, I should perhaps state my own qualifications for offering an opinion. I have never drawn a bead upon a lion, but I have been present when some have been shot by State guests. I have also seen lionesses come to tie-ups when a lion was sought by such guests, and have had several tie-ups and beats purely for purposes of observation, and not for shooting. I have of course discussed the matter with local shikaris and others who have seen many lions killed.

The reasons why the lion is a much easier animal to bring to bag than the tiger or the panther are as follows: In the first place, the lion is, as Colonel Fenton points out, a much noisier animal. He will constantly give away his presence by roaring, which a tiger or a panther does not do except for special reasons. Secondly he is in much more open country, especially in the hot weather. The reader of Colonel Fenton's articles will notice that in several cases he was able to stalk lions under trees, and to fire at them when they were resting or lying down. Such a process would be practically impossible with the tiger or panther. Thirdly the lion is much more sociable, and moves about in troops, often comprising three generations. This may not make it easier to shoot a particular animal, but it does make it far easier for the sportsman who is not very particular, to get something, even if it is only a lioness or a half-grown cub. Fourthly the lion, or at least the lioness, if one or more is accompanying the lion, comes out far more readily to a tie-up. In the case of a very good lion, shot two years ago by a visitor from England, the lion came out almost immediately in broad daylight to a goat tied in the open when there had been no previous kill. It is true that, when there are lionesses, the lion, or the principal lion, seems to prefer to send them out first, either to spy out the ground, or to do the work of killing, or perhaps from the more gentlemanly motive of giving the lady the first morsel. In at least three cases, I have known the lioness to come out and do the killing, while the lion

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has kept in the background throughout. In another case the lioness did a long stalk towards the tie-up, a young buffalo, through a cotton field, and finally lay down within a few yards of it, without attacking it, presumably waiting for the assistance of the lion. She was, however, more patient than we were, and we had to frighten her away when we got down. In a recent case, the lion did come first, and made no attempts to kill, and the lioness came out afterwards and did the killing: but she was a young animal, and the lion seemed to watch her performance with benevolent interest. It is usual to tie-up for lions in the day-time both a goat and young buffalo. The goat is invariably taken first because, as the shikaris say, the lions want to tackle the more serious problem of the buffalo in quiet. Panthers do, of course, occasionally come to tie-ups with extraordinary boldness, but they do not often come, unless they have already killed at the place, with such openness and in such broad daylight as the lions do.

My experience of drives for lions is small, but I should say that, while the lion comes rather faster than the tiger generally does, he gives more notice of his approach, and avoids the open spaces less than a tiger would do. He consequently gives an easier shot.

An obvious cause of their undoing is the confidence of the lions. When they know that they are not often interfered with, they naturally appear more boldly in the open. A good instance of this occurred at our Christmas Camp last year. A lady and a man were riding with an orderly in the afternoon. The lady, riding ahead, came sharply round a corner on a forest road on to a lioness rolling in the dust of the road. The lioness got up, went to the side of the road, and stood there while the riders went past. The remarkable thing was that while the lady's horse started slightly, the other two did not seem to see or mind the lioness. The animal was almost certainly one that we saw in a beat two days later, a very fine lioness of a much more golden colour than is usual with the Kathiawar animal. In another case, a family of lions allowed the inmates of a car to get out and take some cinema photographs of them without any uneasiness.

It is obvious that an animal so easily brought to hand could only be kept extant by strict preservation. This was applied, so far as the Junagadh State is concerned, during the period of Administration, and has since been maintained by His Highness the Nawab of Junagadh. During the Administration, not even a Governor of Bombay, for whom the shooting of a Kathiawar lion had become almost a hereditary 'hukk', was invited to shoot in the Forest. Unfortunately, though the true Gir Forest lies almost wholly within Junagadh limits, the borders of it extend into at least five jurisdictions. At first, with the cordial help of the Agent to the Governor in Kathiawar, the other jurisdictions readily assisted in the work of preservation. The Darbar of one large State agreed originally to drive back into Junagadh limits any lions that strayed across. This abnegation proved too trying for a British Officer who shot several of such animals: but even then it was agreed that only male lions that were actually doing damage should

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be shot. Now, however, any such restriction seems to have gone by the board.

Lions require a particular environment as a breeding haunt and it is believed that there are no suitable areas outside Junagadh territory. But the animals are easily enticed across the boundary by a succession of tie-ups. It is not only the rulers or officials of these jurisdictions that shoot the animals, but the practice has now begun in one jurisdiction at least of inviting guests from long distances to shoot the lions. One of these guests assured me that he only enjoyed watching the animals. This may have been his only enjoyment, but I was afterwards told that he had shot a young lion and two lionesses. To our certain knowledge, because the news of the slaying of an animal rapidly spreads, twenty-two animals have been so slain within the three seasons ending in 1934. There may have been more but there certainly have not been less. Now it must be agreed that the lions do stray voluntarily, apart from enticement. This occurs particularly during the rains, when insects are bad in the Gir. At that time, however, there is little shooting. Doubtless, however, the lions do damage occasionally: but they would easily be frightened away, if the full-grown males were shot, and no great damage would be done to the stock of lions thereby. No such restriction is observed in practice. Perhaps because, as I have noted above, lionesses and half-grown cubs come most readily to the tie-ups, nearly all of the twenty-two animals I have referred to have belonged to these categories. In one case five animals, none so far as I could ascertain of full size, were shot by the young members of one family. In another, four animals, a young lion, two lionesses and a cub were practically ringed in, and were slain, all the four being claimed as falling to the rifle of one young sportsman.

I believe that it is sometimes suggested that the Junagadh State is selfish in trying to restrict, and, as it is alleged, reserve for itself the shooting of lions. If this is so, the selfishness is not personal. His Highness the Nawab, though a keen rifle shot, has shot only one lion during the fourteen years that have passed since he assumed the Government of the State. There is not an official in the State who has fired at a lion. If every year the State has the very real honour and pleasure of entertaining distinguished guests for a lion shoot, it is a distinction which costs a good many thousands of rupees. There is also the steady annual cost of the sums paid in compensation to villagers and herdsmen whose cattle have been killed by lions. When the State hears of people being invited from afar to shoot the lions bred in its limits it cannot be a matter of surprise if the game sometimes seems hardly worth the candle.

I am often asked how many lions still remain in the Gir. As I have said above, there were supposed to be less than a dozen in 1880, and about the same at the beginning of the century when Lord Curzon's visit was cancelled. As a result of the strict preservation during the Administration the number was believed to have increased to fifty, though even in those days poaching was not unknown. It has since been stated in the London *Times*, and

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the statement is quoted in General Burton's book, that there are now two hundred lions. I believe this number to be greatly exaggerated. The fact that lions move in troops, and that they cover long distances leads to over estimation. If a man sees a troop of six or seven animals, and hears of a similar number some miles away within a few days, he naturally fixes too high a number for the whole forest. My own opinion though it is only a guess is that there are not much more than 75 to 80. It is obvious that this number cannot stand a drain of ten or twelve being shot yearly, especially if the animals so killed outside Junagadh limits are all of young breeding stock.

It may be observed that there is no real excuse for shooting a lioness in mistake for a lion. Even if the shooting of female tigers and panthers were regarded as being unsportsmanlike and reprehensible, the sportsman might well plead that he had not sufficient time, or sufficient knowledge, to distinguish. But he could not truthfully say so in the case of the lioness. A lion which is not easily distinguishable as being such, must be very young and worthless as a trophy to the self-respecting sportsman.

What then is the remedy to be adopted against unfair or unwise shooting? It has been recently proposed in a high official quarter that all the jurisdictions concerned, that is all those which possess or border upon any portion of the Gir Forest, should agree to refrain from shooting within a mile from the boundary of another jurisdiction, and from shooting any but full-grown males. This would lead to some improvement though in two recent cases the condition that the animal shot should be a full-grown male has been, I am informed, somewhat liberally interpreted. But it may be doubted whether this is enough, and I venture to think that it would be better to come to an agreement that the total number of lions to be shot in one year should not exceed some such figure as five or six.

The pressure on Junagadh of suggestions for invitations to shoot lions is, it may be observed, increasing year by year, and the Junagadh Darbar would gladly welcome some such limitation. Unless an agreement is reached, and is faithfully observed, the danger of the disappearance of the lion from the fauna of India, and consequently from its last home in Asia, is obvious.

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No. 6. WILD LIFE PROTECTION IN BURMA.

BY

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I. THE NEED FOR PROTECTION.

General.

Most civilised Western nations have now realised what Burma has yet to learn, namely, that the perpetuation of an indigenous fauna is essential for a country's welfare.

The perpetuation of wild life is impossible under modern conditions without the enforcement of protective legislation. Burma unfortunately has as yet failed to realise the necessity for such protection and unless she takes immediate and vigorous steps to cast off the apathy which up till now has characterised the attitude of her general public towards all matters pertaining to the perpetuation of wild life she will most certainly be too late as irreparable damage will have been done.

Endowed by nature with a wild fauna which in variety, beauty and interest compares most favourably with that of any country in the world it is the bounden duty of the present generation to hand it down to posterity in as complete a form as possible.

In the early stages of the Province's development wild animals and birds of all kinds were plentiful, guns were few and consequently there was little need for elaborate protective legislation or at any rate for its rigid enforcement.

Recent years, however, have seen a marked change in conditions

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generally, communications have been improved; more country has been opened up; cultivation has been extended, curtailing the area available for occupation by wild life; and an enormous increase in the number of firearms throughout the province has resulted in the indiscriminate slaughter of numerous kinds of animals and birds, especially in the more accessible districts.

Development must, of course, continue and wild life must, just as inevitably, recede before it, but, in a country like Burma, there is no reason why the indigenous animals should not be perpetuated for all time in certain areas without their presence in any way impeding future national progress. Such animals as tigers, elephants and *thamin* are entirely out of place, and their presence cannot be tolerated in the immediate vicinity of human dwellings or intensive cultivation, but in most of the reserved forests of the country their existence is not only welcome but must be considered an important national asset. Wild animals may be destructive to crops but they are generally harmless to man unless man attacks them first and wounds them. Even a tiger except in the rare cases in which he has turned man-eater goes out of his way to avoid man, and people with a true knowledge of the jungle pay very little attention to his presence unless he starts raiding their cattle.

The main reason why so little interest has up till now been taken in the protection of Burma's fauna is undoubtedly that most people are extremely ignorant on the subject. They do not realise that the possession of a number of wild animals and birds is a very valuable asset to the province nor do they realise that the stock cannot last for ever unless certain restrictions are imposed on its destruction.

To the jungle Burman all ideas of protection are not unnaturally entirely foreign and he instinctively looks for guidance in such matters to the educated classes. If, therefore, the latter fail to set the correct example he can scarcely be blamed for his irregularities.

The average villager has always been accustomed to obtain plenty of everything with very little trouble and is quite oblivious of the fact that supplies must soon come to an end unless their use is systematically controlled.

Bamboos, houseposts, thatching, firewood and water he has always been able to get with ease close to his village. Paddy he has been able to grow with the minimum amount of exertion and wild animals and birds he has regarded as things to be killed whenever possible either to provide meat or else because they damage his crops.

It is extraordinarily difficult to make the villager realise that if he goes on wastefully cutting timber and fuel according to no plan there will soon come a time when the supply will run out and either he or his descendants will suffer in consequence.

One of the main duties of educated Burmans should therefore be to help villagers to realise that with the spread of development and increase in population the time has come when the unrestricted exploitation of all kinds of forest produce cannot be tolerated.

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Wild animals and birds are a very valuable form of forest produce and need to be conserved every bit as much as bamboos, timber and fuel.

If only people from Burma could see for themselves the conditions existing in parts of India and other countries where development has already advanced much further than it has at present in Burma and note the distress which has been caused by the wholesale destruction of forests and all that they contain, they would most certainly wake up and take steps now lest the countryside of Burma should share a similar fate.

While it should be a comparatively simple matter to make the villager understand the necessity for the maintenance of a continuous supply of timber, fuel and bamboos, it may not be quite so easy to persuade him that the preservation of a stock of wild beasts is equally advantageous.

Certain wild animals have from time immemorial damaged his crops, killed his cattle and at times also endangered his life and he has therefore, grown up to regard them as his natural enemies to be killed whenever and however possible. Other wild creatures, though quite harmless, he has regarded as meat, of which he has always tried to obtain as much as possible in the easiest way.

Reasons why Wild Life should be protected.

In any country the perpetuation of an indigenous fauna is necessary for commercial, agricultural, scientific, aesthetic and sporting reasons. In Burma the precepts of the Buddhist religion must surely provide an additional cause for protection.

A large portion of Burma's wealth is derived from timber which cannot be economically extracted without elephants. These animals cannot live for ever and a supply of wild elephants must always be maintained from which the domestic herds can be replenished and increased as trade expands.

A considerable amount of revenue is realised annually on account of license fees and royalty paid on the collection of various parts and products of wild animals. There is no reason why this revenue should not be greatly increased with careful management without the fauna being in any way adversely affected.

An immense amount of good is done by many kinds of birds by destroying insects and other pests which would otherwise prey upon crops, domestic animals or human beings. Woodpeckers, owls, nightjars, egrets, drongos, rollers and mynas, are particularly useful in this respect.

A vast amount of information of use to science has been acquired in the past from the study of wild animals and a great deal more awaits discovery. The stocks of specimens in museums throughout the world will not last indefinitely and must therefore be periodically replenished.

Most wild animals and birds add very considerably to the beauty and interest of a countryside by their presence. A country devoid of all wild life, is unnatural, and under such conditions the national character must be adversely affected.

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The study of the habits and ways of wild creatures provides one of the healthiest and most beneficial forms of amusement for the people and needs all possible encouragement. Townspeople have few opportunities to study wild animals in their native haunts and have therefore to be content to do so in Zoological Gardens and National Parks. These institutions are increasing in popularity all over the world and their stocks of wild animals and birds will require periodical replenishment.

The pursuit of certain wild creatures *in strict accordance with the dictates of sport* provides one of the finest forms of training for the country's youth and of recreation for its manhood. Individual skill and physical prowess are involved in the location and coming to close quarters with most kinds of wild animals. Perseverance, patience, ability to overcome hardship and difficulty, power of endurance and mental and physical fitness are all virtues which are cultivated and fostered by the pursuit of wild beasts and since these are the qualities which go to make the ideal citizen or soldier every effort should be made to induce the youth of the country to acquire them.

It is the overtaking and the outwitting of an animal which provide the training and the recreation and it matters little whether observation, photography or killing is the ultimate object. To Buddhists whose religion forbids them to take life the first two objects will naturally appeal whilst others will probably wish to kill to obtain a trophy.

II. Legislation.

Existing Legislation.

The legislation at present in force for the protection of the fauna of Burma consists of the following:—

(i) The Burma Game Rules, 1927, together with certain notifications and special orders issued under them. These are all issued under the authority of the Burma Forest Act, 1902.

(ii) The Wild Birds and Animals Protection Act, 1912, which applies to the whole of British India.

(iii) The Indian Arms Act which provides for the control of guns and cartridges used against wild animals and which is also an all-India Act.

These laws together with certain other matters of interest to sportsmen are contained in a *Burma Game Manual* which is on sale to the general public at a price of twelve annas.

Also, since the regulations have necessarily been written in much detail and in legal phraseology which may not be readily understandable to some, an abstract containing their salient points but having no legal significance has been compiled. This abstract which is in the form of a pamphlet entitled *Game Law in Burma* has been prepared in both English and Burmese for general circulation *gratis* in the Districts.

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The existing laws whilst making adequate provision for the destruction of wild animals which are a menace to human life and property, for the obtaining of scientific specimens and for the killing of game for sport should, if only they are enforced, afford reasonable protection to the fauna of the Province.

In *bona fide* defence of life or property any person may kill a wild animal in any way he pleases.

The killing of game for the purpose of sport is controlled by the issue of game licenses, particulars of which can be obtained from any Divisional Forest Officer.

It is illegal to hunt any kind of wild animal or bird inside a reserve forest or game sanctuary without a game license.

All wild animals and birds except the following, namely rhinoceros, tapir, buffalo, *mythun*, elephant, bison, *saing*, serow, goral, Argus pheasant, bittern, crane, drongo, egret, heron, hornbill, kingfisher, nightjar, oriole, owl, roller, stork, tern and woodpecker may be hunted anywhere outside reserved forests and game sanctuaries without a license but subject to the conditions of the schedule of close seasons which is reproduced in full below:—

The Schedule of Close Seasons.

No one may hunt any animal or bird mentioned in column 1 of this Schedule during the period mentioned as its close season in column 2 whether inside or outside a reserved forest with or without a license.

1.	2.
Males and Females of:—	
Rhinoceros Tapir Buffalo *Mythun*	
Females of:—	
Elephant Bison *Saing* *Thamin* Hog Deer Sambhur	... The whole year.
Males of:—	
All species of deer, if hornless or with horns in velvet.	
Males and Females of:—	
Serow Goral *Gyi*	... 1st July to 31st October.

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The Argus pheasant and all species of :— Bittern Crane Drongo Egret Heron Hornbill Kingfisher Nightjar Oriole Owl Roller Stork Tern Woodpecker	... The whole year.
All species of :— Peafowl Pheasant (other than Argus pheasant) Partridge Painted Snipe Plover Quail	... 1st March to 31st August
All species of :— Jungle Fowl	... 1st April to 30th September.
The Masked Finfoot and all species of :— Duck Teal Moorhen Jacana Watercock Grebe	... 1st May to 31st August.

Note—(i) Special licenses are issued for kheddah operations.

(ii) Immature males of elephant, bison and *saing* may not be hunted at any time.

Mature males are defined as follows :—

Elephant.—Either tusk measured along the outer curve must project at least thirty inches from the gum or must exceed fourteen inches in girth.

Bison.—The horn must measure at least twenty-two inches along the outer curve or must show clearly defined transverse corrugations extending for at least four inches from the base.

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Saing.—The horn must measure at least twenty inches along the outer curve or must show clearly defined transverse corrugations extending for at least four inches from the base.

Under Rule 4 of the Burma Game Rules certain methods of hunting are prohibited and except when animals are actually menacing human life or property no one may—

(*a*) shoot any animal with poisoned arrows;
(*b*) lay down poison for any animal;
(*c*) net wild water birds;
(*d*) hunt any animal by means of pitfalls;
(*e*) hunt within one hundred yards of the compound of a Buddhist monstery;
(*f*) hunt any animal during the period shown to be a close time for that animal;
(*g*) shoot any animal other than carnivora from any platform or machan;
(*h*) use artificial light for the purpose of hunting any animals other than carnivora;
(*i*) shoot animals other than carnivora from the back of an elephant or from any kind of vehicle;
(*j*) sell or buy, or offer to sell or buy or possess or destroy the eggs of any of the birds mentioned in the schedule at any time of the year; and
(*k*) hunt any animal named in the schedule for purposes of trade except elephants which are hunted in accordance with a special license.

Under Section 3 (b) of the Wild Birds and Animals Protection Act, it is unlawful in respect of any wild bird or animal for which a close season has been declared in the schedule of close seasons, to sell or buy or offer to sell or buy or to possess any such bird or animal which has not been captured or killed before the commencement of such close time, or the flesh or any other part thereof.

Under the Indian Arms Act it is illegal for anyone to lend a gun or rifle or supply cartridges to any person unauthorised to possess them.

Revision.

In 1925 in view of the increasing number of firearms and the development of the country, the Game Rules then in force were found to be inadequate to safeguard the fauna against serious depletion. A thorough revision of the Game Rules was considered necessary and the appointment of a Game Warden was found to be essential for the proper protection of the wild fauna. The Game Rules and the special orders and circulars under these rules were accordingly revised; the capture and control of wild elephants were systematized and a Game Warden was appointed.

The Burma Game Rules, 1927, came into force on the 1st November of that year and it was laid down that they should be revised after five years. They are now due for revision and since there are many points requiring consideration the matter should receive attention as soon as possible. At the same time, all exist-

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ing legislation for the protection of the fauna should be thoroughly scrutinized by a body of men representative of commerce, agriculture, forestry, science, sport, religion and aesthetics.

A revision of the Game Rules will entail, amongst other things re-editing the *Burma Game Manual*, the Game Law pamphlets and the various Game licence forms, all of which work should be undertaken by a whole-time Game Warden who at present does not exist.

In 1931 as a measure of retrenchment the post of Game Warden was suspended. Financial stringency cannot justify such a retrograde step in regard to a post on which the total annual expenditure was approximately £1,000 irrespective of compensating revenue.

The rehabilitation of the post of Game Warden is essential if the progress made with wild life protection during the past five years is to be maintained.

A Wild Life Protection Act for Burma.

The Burma Forest Act of 1902, under the authority of which the Burma Game Rules, 1927, are issued only applies to reserved forests and public forest land. It is not applicable to private land.

The Wild Birds and Animals Protection Act, 1912, an all-India Act, applies to private land but no particular class of officer is responsible for its enforcement.

These two disadvantages were fully realised in 1926 when a new draft Act for Burma incorporating the pertinent portions of both the above Acts was drawn up, but never pressed for in the then newly constituted Legislative Council. The need for such an act has not lessened during the past five years and the Burma Game Rules and Wild Birds and Animals Protection Act should now be replaced by a special Wild Life Protection Act for Burma.

Necessary Amendments.

During the past five years a number of weak points in the existing rules have been shown up and certain amendments deserving consideration have been proposed. At the time of revision all criticism whether it be of a constructive or destructive nature should be carefully considered by a representative body.

The most urgent requirement at the moment is legislation to control the exposure for sale or barter of all wild animals or birds or parts thereof at all times and in all places. Until such legislation is introduced and enforced it will be practically impossible to prevent the netting and snaring of wild fowl for trade purposes which is carried on extensively to the accompaniment of great cruelty.

The schedule of close seasons requires careful scrutiny mainly with a view to removing petty inconveniences to sportsmen and making things still simpler for the uneducated.

Close times have been fixed so as to coincide as far as possible with the breeding seasons of the scheduled animals and birds using a minimum number of dates to avoid unnecessary complication

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and with due consideration for the requirements of sportsmen. In Burma, where certain animals breed the whole year round and birds of one kind or another lay their eggs in every month of the year, the compilation of an effective schedule on these lines is not easy.

The young of Barking Deer (*gyi*) may be born in any month and so these animals were given an arbitrary close season from the 1st of July to the 31st of October, this being the period during which it was thought that fewest sportsmen would be in the jungle. It now appears that many people like to spend their October holidays shooting and are inconvenienced, probably unnecessarily, by October being a closed month for *gyi*. If the existing close season for the males and females of serow, goral and *gyi* were altered to the 15th June to 30th September, many sportsmen would be satisfied whilst the animals in question would be none the worse off.

In 1926 the list of birds included in the schedule underwent close scrutiny and was considerably simplified, nevertheless, further modification is now necessary. The list, which as it now stands, includes approximately 260 species and sub-species, should again be carefully scrutinised by a representative body. An authoritative list of the Burmese names of all scheduled birds should be compiled.

In addition to the above proposals a number of minor amendments have been suggested many of which deal with technical points in connection with the administration of the rules. All these should receive due consideration as soon as a Game Warden and a representative body competent to deal with the situation can be appointed.

The Enforcement of the Laws.

In the past, the non-enforcement of certain protective measures was, to a certain extent, justified by conditions prevailing at the time, but now it is necessary to emphasize the fact that nothing short of a very strict observance of all such legislation in future can save the fauna from serious depletion and the province from a lasting reproach in consequence.

It is, of course, unreasonable to suppose that laws which have hitherto not been strictly enforced can all at once be enforced or that the apathy which has uptill now characterised the attitude of the general public towards Wild Life Protection can, at a moment's notice, be converted into an enthusiasm for the furtherance of such a cause. Nevertheless, it is hoped that when the change in conditions is realised the whole community will take up wholeheartedly the question of the protection of its wild fauna.

In Burma the executive department so far as the protection of the fauna is concerned is the Forest Department and Forest Officers supervise the regulations for the protection of Wild Life in their jurisdictions to the extent to which they take an interest in the matter and have the time to do so. This position may be unsatisfactory but, under existing conditions, it is possibly the best that can be attained.

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A Forest Officer's duties give him exceptional opportunities for observing the conditions relating to wild life and for developing a sympathetic interest in the preservation of the wild fauna. It might be supposed, therefore, that the Forest Department would contain a large proportion of field naturalists and lovers of nature yet the hard fact is that only a small percentage of Forest Officers have anything but a superficial knowledge of the fauna in their forests or evince any real enthusiasm for affording it adequate protection. Naturalistic ability and interest in the wild fauna are not part of the compulsory equipment of Forest Officers and a progressive policy in respect of Wild Life Protection involves additional work which is neglected by a larger proportion of the Forest Establishment than might be expected.

In the majority of cases the local heads of Forest Circles and Divisions in common with many senior officials of other Government Departments, are men from overseas whose interest in handing down to posterity an undepleted fauna can in no way approach the viewpoint of the average colonial. This migrant official personnel to whom is entrusted the control of all matters affecting the fauna, however conscientious it may be in regard to the work for which it has been trained, cannot as a whole, raise sufficient enthusiasm over an optional interest in a country in which it has no intention to settle permanently.

Modern conditions of service have aggravated the situation and there is a growing tendency amongst officials to dissociate themselves from any but those matters which are part and parcel of their contracts and agreements. Increased office work often makes it impossible for district officials to spend sufficient time on tour and Forest Officers, with many special duties to perform in connection with their appointments, cannot usually devote sufficient time to the supervision of regulations for the protection of wild life which is frequently in parts of the country where forestry operations are practically non-existent. Leisurely touring in remote areas, which is so essential for effective Wild Life Protection and also incidentally, for the proper administration of a district, is no longer encouraged.

Within the last three years the situation has been further aggravated by the rebellion in Lower Burma and the economic crisis which has affected the whole Province. During the rebellion general lawlessness prevailed throughout several districts and in some forests it has only recently been possible to resume normal touring. The financial crisis led to a substantial reduction in the Forest Establishment and to an amalgamation of certain Forest Circles and Divisions. During this retrenchment Wild Life Protection received little consideration with the result that certain Divisional Forest Officers now find that it is quite impossible to enforce protective legislation throughout the vast areas under their charge.

The officers of the Forest Department are most directly concerned with the enforcement of the Game Laws but it is obvious that no matter how enthusiastic they may be, their efforts must be largely nullified unless they receive strong support from members of other departments and the general public as well.

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Isolated individual efforts can achieve little in a case like this; what is required is a concerted effort on the part of every one for the attainment of the common end.

At present an active form of public opinion in favour of Wild Life Protection which plays such an important part in the enforcement of the laws in Western countries, is almost entirely lacking in Burma, and until it is created it is unlikely that a great deal of progress will be made. Its creation, however, should not prove a difficult matter if every sportsman in the country would make up his mind once and for all to adhere rigidly to the letter of the Law himself and make a determined effort to see that his subordinates and followers do the same. If all such men would learn to regard the non-observance of the Game Laws as unsporting and those who infringe them as persons not playing the game the desired form of public opinion would soon be created.

Ignorance of the necessity for protective legislation and even of its existence has undoubtedly often been the cause of numerous infringements in the past, but in these days there can be little excuse for a serious breach of the law at any rate on the part of an educated person.

Under existing conditions the killing of wild animals and birds for food alone cannot be justified, for when due allowance is made for the numbers which must be killed annually in defence of life and property, properly regulated shooting for sport is all that can be tolerated. These facts have been given due weight in the compilation of the existing laws, and if only these are strictly observed there need be little fear of any species ever being irreparably reduced in numbers.

Breaches of the Laws.

The practices of lending out guns and disregarding the close seasons, above all others are responsible for most harm to the fauna.

Many persons possess guns which they have little desire or ability to use themselves but they are nevertheless very fond of meat. They, therefore, lend their weapons to others to procure meat for them. The persons thus employed usually have little regard for the age or sex of their victims and pay little heed to the game laws or the dictates of sport.

The lending of a gun or rifle or giving of cartridges to persons unauthorised to possess them are practices which, besides being illegal, dangerous and unsportsmanlike, are, more than any others hostile to the cause of Wild Life Protection.

In respect of the disregard for the close seasons the plea is frequently brought forward that men who are compelled to spend most of their time in the jungle should be allowed a certain amount of licence regarding the observance of the Game Laws. This is all very well, but in Burma no kind of Game exists in such numbers that its destruction purely for food purposes in contravention of the game laws can be justified.

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If every one who earned his living in the jungle was allowed to obtain as much meat as he liked in any way he liked, then the wild fauna would very soon be exterminated.

In addition to lending out guns and non-observance of the close seasons there are other factors the effects of which, though not so far reaching, nevertheless form a considerable menace to the wild life of the country.

Recent years have seen a very large increase in the numbers of domestic cattle owned mainly by Indians. The herds in places have assumed large proportions, and containing as they do numerous weak and sickly animals they foster the spread of cattle disease besides consuming well nigh the entire food supply which belongs legitimately to the draught cattle of the local villages and the indigenous fauna. Every hot weather large numbers of *saing* and other wild animals succumb to disease which apparently originates with domestic cattle, and unless steps are taken to restrict the numbers and wanderings of the prolific herds, many of which appear to serve no useful purpose, considerable harm is likely to result.

Among a certain class of *shikari* the shooting of deer, pig and even *saing* and bison by lying in wait for them in *machans* or in 'hides' built near salt-licks, waterholes, wallows and game tracks is most popular. By this method at certain seasons of the year great destruction can be done, and if the method were to be consistently employed on a large scale game could be practically wiped out of most areas without much difficulty. In a country like Burma which carries such a very small head of game per square mile and in which for several months of the year animals are compelled through scarcity of water and fodder to concentrate round certain definite spots, such a method can never be permitted without the fauna suffering irreparable loss in consequence. Determined efforts are therefore needed to put a stop to these practices and to strengthen public opinion against them.

The shooting of *thamin* from carts and of other animals from the back of an elephant are practices which cannot be permitted. *Thamin*, in certain areas, can be approached comparatively easily in a cart, and most animals will allow an elephant with a man on its back to get to within shooting range before making off, with the result that by the adoption of such methods they can be easily killed.

A modern invention which is instrumental in the destruction of large numbers of hog-deer and to a lesser extent of other animals throughout the province is the electric torch. Its comparatively small cost and the ease with which it can be obtained has placed this article within the reach of all who can handle a gun and the damage which is now being done with it is very considerable. A deer when feeding out in the open at night can be located at a long distance with the aid of a powerful torch and the animal being apparently stupefied will allow the 'sportsman' to walk to within easy gun-shot range of it before making off. The result of this is that fields and open spaces are patrolled at night by men armed with torches and guns, and as many as half a dozen deer are

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often accounted for by one gun, in a single night. Needless to say, the shooter does not trouble himself about the sex or age of his victims. Many kinds of animals are killed with the aid of torches, but hog-deer probably suffer most.

In certain districts the low-lying areas along the banks of the big rivers become flooded annually during the rains, only small islands of high ground being left above the surface of the water. Wild animals, mainly *sambhur* and hog-deer inhabiting such areas, do not seem to have the sense to leave them before the floods come and become, therefore, marooned on these small pieces of dry land. The neighbouring villagers are quick to take advantage of this fact and sally forth in boats with dahs, spears and dogs, and generally make short work of any animals they find. Many animals are killed in this way every year.

In addition to the illicit methods of killing already mentioned a certain amount of trapping and snaring is always going on, generally practised by jungle villagers with the aid of various primitive and at times most ingenious devices. The amount of damage done in this way is not serious and is in fact negligible when compared with the devastating effects of illicit shooting.

III. Sanctuaries and National Parks.

Most civilised countries have now recognised that no policy of Wild Life Protection can hope to be a permanent success unless it is built on a foundation of secure sanctuaries. Inviolable sanctuaries must be constituted to ensure that a limited number of representatives of every species of an indigenous fauna are perpetuated for all time.

In England there are a number of Game Sanctuaries and additional sanctuaries are continually being constituted. In South Africa and Canada where their national value is perhaps more fully appreciated than anywhere else, sanctuaries occupy thousands of square miles and are visited by over a million people annually. These vast sanctuaries which, besides assisting in the perpetuation of wild life, afford recreation grounds for masses of the population are termed 'National Parks'. People from the cities and large towns flock to them annually in increasing numbers and spend their holidays observing and studying the wild creatures amidst magnificent scenery thus benefiting enormously from the healthy exercise and fresh air.

If only the youth of Burma could be persuaded to divert its attention from the cinemas and less healthy places of amusement in Rangoon and other towns and take a delight in improving its general fitness in a like manner, how very much better it would be for the province as a whole.

In Burma there are at present five areas notified as sanctuaries covering a total area of approximately 400 square miles. This considering the total area of the province and the variety of its fauna is quite inadequate and further areas will have to be notified in the near future if all species are to receive the protection they require.

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Burma's existing sanctuaries are as follows:—

Name of sanctuary	Area in Sq. miles	Forest Div. in which situated	Species for which the sanctuary is primarily constituted
Pidaung ...	260	Myitkyina ...	Elephant, Bison, *Saing*, Sambhur, Hog-Deer, *Gyi*, Pig, Tiger, Leopard, Bear.
Shwe-U-Daung	81	Mogok ...	*Rhinoceros sumatrensis*, Elephant, Bison, *Saing*, Sambhur, Serow, *Gyi*, Pig, Tiger, Leopard, Bear.
Maymyo ...	49	Maymyo ...	*Gyi*, Birds.
Moscos Island.	19	Tavoy ...	Sambhur, *Gyi*, Pig.
Kahilu ...	62	Salween and Thaton	*Rhinoceros sondaicus*.

The above statement shows that of the larger fauna *thamin* and tapir are totally unprovided for and any one at all familiar with local conditions will admit the inadequacy of the provision made for rhinoceros, *saing* and hog-deer.

Of the existing sanctuaries, Pidaung and Shwe-U-Daung should be raised to the status of National Parks; Maymyo can never be much more than a Wild Bird Refuge and the Moscos Islands sanctuary is of very little value.

The Kahilu sanctuary deserves special attention. Constituted in 1928 primarily for the perpetuation of a family of *Rhinoceros sondaicus*, it is supervised by two Karen keepers on monthly salaries of Rs. 50 and Rs. 30 respectively. *Rhinoceros sondaicus* is now the rarest large mammal in the world and this sanctuary probably contains the only known living specimens. The local market value of the animals is certainly not less than Rs. 2,000 each, whilst their scientific value is inestimable.

Recently, as a measure of economy, Government dispensed with the services of one of the keepers and seriously contemplated dispensing with the services of the other. Instead of considering relaxation of protective measures Government would be well advised to maintain stricter control over the sanctuary with a view to ensuring effective protection in future.

The preservation of these few surviving specimens of *Rhinoceros sondaicus* is one of more than provincial interest and the question of the future maintenance of the Kahilu sanctuary is one which might well be referred to the Society for the Preservation of the Fauna of the Empire.

Two more sanctuaries are urgently required in Central Burma for *thamin* and these should, if possible, be so selected as to include *saing* and hog-deer as well. One of the areas chosen might be on the Katha-Shwebo District boundary and the other on the

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borders of Minbu and Thayetmyo. Both these sanctuaries should be constituted with a view to their being raised eventually to the status of National Parks.

In Lower Burma an area should be taken primarily for tapir and it should also provide for rhinoceros, elephant, bison, sambhur and mouse deer. One of the former habitats of *Rhinoceros sondaicus* near the coast in the Mergui District would probably be most suitable for this purpose.

The adoption of the above proposals would result in Burma possessing six effective sanctuaries, four of which could be raised eventually to the status of National Parks; every species of the indigenous larger fauna would be well provided for and the protection of wild life in the province would be placed on a thoroughly sound foundation.

Sanctuaries, if they are to be effective, must:—

(1) be sufficiently large to allow the animals to live in them the whole year round without having to wander outside;

(2) comprise natural game country possessing abundant food, water and cover;

(3) be undisturbed by timber extraction and other forest works;

(4) be sufficiently accessible to permit of frequent inspection by responsible officers and sportsmen;

(5) be sufficiently inaccessible to prevent the animals from being molested and harassed by villagers and others encroaching upon their boundaries;

(6) be free from grazing rights since domestic cattle in a sanctuary spread disease besides reducing the food supply and disturbing the forest; and

(7) possess security of tenure and not be liable to sudden changes of constitution or control. The present system under which sanctuaries are controlled by officials who are continually being transferred and whose personal idiosyncrasies are often unleaveñed by any permanent and personal interest in the country is most unsatisfactory.

Those sanctuaries which are suitable for constitution as National Parks should be dedicated to the people of Burma for their benefit, education and enjoyment subject to regulations which would ensure that such Parks were maintained and made use of so as to leave them unimpaired for the enjoyment of future generations.

In South Africa the Kruger National Park is controlled by a National Parks Board of Trustees who are not remunerated for their work which is honorary. The possibility of placing all sanctuaries in Burma under the control of a National Trust composed of gentlemen indigenous to the country should be seriously considered. There are probably many educated Burmese gentlemen and many domiciled Europeans and Anglo-Indians who will respond to this suggestion and willingly accept the trust if the situation is brought to their notice. Equally there are certain men from overseas who would abandon every vestige of racial feeling

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in a common sporting instinct and would assist the Trust. That the Burmese people would react favourably is certain.

For effectual control a National Trust would require a field officer to inspect the sanctuaries and advise the Trust. The transfer of sanctuaries to the control of a National Trust would naturally be gradual and, at inception, should be subsidised by Government and the services of an officer or officers lent to the Trust. In course of time those sanctuaries which are raised to the status of National Parks should be self-supporting and in the meantime the expenditure upon all sanctuaries should be met from an allotment made by Government from the revenues derived annually from the means to destroy wild life.

For the proper protection of all sanctuaries and the development of those selected as National Parks the whole-time services of a suitable officer, responsible to the Trust alone, would ultimately be required. Bearing in mind that the personnel of the Trust would be indigenous to the Province its field representative should, if possible, be a Burman. It should not be difficult to obtain the services of a Burmese gentleman for this post. There must be some who are keen sportsmen and naturalists and the existing records of the work already done in connection with sanctuaries would be of the greatest assistance to him. The Provincial Honorary Game Warden and a few other keen wild life conservationists would probably be only too glad to act at first in an advisory capacity.

The wisdom of handing over such an interest as wild life protection in sanctuaries and parks to the control of an unofficial and indigenous Trust will be doubted by many; but there appears to be no other reasonable alternative. It must be remembered that the formation of such sanctuaries as there are and practically all that has been done for the credit of Wild Life Protection in Burma has been the work of only a very few enthusiasts whose efforts are now in danger of being nullified by the opposition or indifference of officials who have very little permanent interest in the country. The recent history of Wild Life Protection and the forecast suggests that wholly official control on past lines is likely to lead to a worse condition than is the case at present. The introduction of unofficial and national interest may save the situation; at the worst it can hardly lead to worse conditions than those obtaining. It is worth remembering also that an indigenous Trust could sway public opinion and enlist the support of the ubiquitous and often very influential Burmese priests in a manner outside the scope of the overseas official.

IV. Sport.

From the sportsman's point of view Burma possesses many attractions. There are few Forest Divisions in which fair sport with 'big' and 'small' game cannot be enjoyed whilst in certain selected places the possibilities are excellent.

As the development of the country proceeds and the tenure of all waste land becomes settled the larger fauna must inevitably

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be forced to take refuge in reserved forests. These State forests are extensive and provided that adequate sanctuaries are constituted on the lines already proposed there is no reason why 'big game' should not be perpetuated to accommodate an almost unlimited number of local and visiting sportsmen without any fear of the stock being seriously depleted.

Since the success of Wild Life Protection in the future will depend very largely upon the education of the jungle Burman it is desirable that sportsmen of the right type should visit the more remote forests periodically and endeavour by precept and example to teach the villager to take more interest in the local fauna and its protection. Nowadays, local officials, however keen they may be on sport and natural history, can seldom spare the time to discuss these matters in the villages and jungle in the way that sportsmen on holiday can afford to do.

Statistics show that the head of 'big game' killed annually under sporting licenses is negligible and hitherto there has been a tendency to discourage outside sportsmen from visiting the Province. Propaganda and advertisement of the country's resources have been neglected until the publication of Mr. Peacock's[1] book there was hardly a modern publication of any real assistance to visiting sportsmen.

The cost to a visitor of one elephant shooting license plus an ordinary Game license is Rs. 450. The fact that a flow of outside sportsmen shooting under a proper system of shooting blocks would not only benefit Wild Life Protection by embarrassing poachers but yield large direct revenues does not seem to have been appreciated. Obviously there would be other attending benefits, not the least being that healthy outside criticism and advice with regard to local protective methods would be forthcoming.

During the period 1927 to 1931 when a Game Warden was in office conditions improved. Visiting sportsmen and naturalists were assisted with advice and information and several expeditions were personally conducted. With the suspension of the post of Game Warden decentralisation in these matters was inevitable. An Honorary Game Warden with no special clerical establishment and heavy Forest Divisional work to attend to cannot devote much time to the assistance of sportsmen and so all progress in this direction has unfortunately been stopped.

V. Kheddah Operations.

The capture and training of Wild Elephants is controlled by a 'Plan of Kheddah Operations for Burma' which has been drawn up for the period 1931-32 to 1939-40. Under this plan certain areas have been closed to operations as elephant sanctuaries, others have been classified as areas in which the extermination of elephants is desirable in the interests of the country's development; the greater

[1] 'A Game Book for Burma and Adjoining Territories' by E. H. Peacock, Deputy Conservator of Forests and Game Warden, Burma (retired). H. F. & G. Witherby, 326, High Holborn, London, W. C. Price 12*s*. 6*d*. net.

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part of the province in which wild elephants occur has been divided into a number of kheddah blocks to be worked over in rotation by kheddah licensees.

Prior to the compilation of this plan the control of kheddah operations was decentralised in local district officials, many of whom had but a superficial knowledge of the work and often no time in which to supervise it. This resulted in irregularities, unsystematic work and excessive mortality among the captured elephants. Experience showed that centralisation of control was essential for efficiency and the Plan of Kheddah Operations was drawn up on the assumption that control would be centralised in a Game Warden.

During the short time in which a whole-time Game Warden exercised control, much headway was made. Kheddahs were visited periodically and running records were kept of the work of all licensees. By comparison and a study of the work in different Forest Divisions the Game Warden was able to sum up the resources and capabilities of each licensee. The best men were encouraged and those whose work was consistently unsatisfactory were eliminated in order to make room for new men deserving a trial. The general standard of work was raised and the mortality percentage reduced.

With the suspension of the post of Game Warden progress ceased and control is now once more becoming decentralised in local officers. The Honorary Game Warden cannot supervise Kheddah work in Forest Divisions other than his own; the most he can do is to issue licenses and maintain the records from reports sent to him by Divisional Forest Officers. This arrangement is most unsatisfactory and particularly disheartening to those who have laboured to set kheddah work in Burma upon a sound foundation. Government's accepted policy is to raise the standard of work and to build up a reliable and humane agency for the capture and training of wild elephants. These objects can never be achieved with decentralised control.

VI. Elephant Control.

So long as a stock of wild elephants is maintained in Burma periodic damage to cultivation by herds is bound to occur and individual rogue elephants will, from time to time, cause trouble.

Kheddah operations may do good indirectly by reducing the number of elephants available for doing damage, but they also aggravate the trouble by driving elephants towards cultivation from the more remote forests in which the stockades, to be of any use, must be situated. They also tend to break up herds and scatter individuals and small parties over a wide area.

The present arrangement under which anyone may kill by any means, elephants which are actually damaging crops is open to grave objection. It entails shooting at elephants by night with shot guns and light rifles and wounding elephants in traps. This has the effect of turning otherwise normal animals into rogues which become a menace to human life and are often most difficult to destroy. Similarly the system under which individual rogue

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elephants may be proclaimed by a Deputy Commissioner is unsatisfactory since it authorises any person to hunt an elephant with any kind of weapon. Great harm results from inexpert and indiscriminate shooting, which is entirely foolish and utterly wrong; nevertheless it must continue until Government removes its excuse by undertaking a properly co-ordinated system of elephant control.

As soon as a satisfactory system of control is in force it will be possible to review the present general exemption given to persons to kill elephants in alleged defence of life and property. It is an established fact that a large percentage of guns which are licensed for crop protection are used for poaching. Many of these guns could be withdrawn provided an efficient system of elephant control was introduced.

Without further delay at least six men should be recruited, trained and kept in readiness to deal with crop raiding and rogue elephants in any part of Burma. These men armed with Government Rifles and working under a set of comprehensive rules should be sent to districts as required. In addition to ordinary crop protective work in the permanent kheddah blocks, these experts would complete the extermination of elephants in those blocks in which extermination is desirable and in which the elephant stock has been reduced to a level at which kheddah operatives can no longer be induced to work. The men should be recruited, trained, paid and controlled by a Provincial Game Warden.

VII. A Wild Life Protection Society.

Attention has been invited to the critical conditions which are affecting the fauna of Burma, the urgent necessity for remedial measures and the ways in which the situation may be improved. Most of the proposals put forward invite action on the part of the local Government, and Government is disinclined to act in matters of this nature in the absence of public opinion. In Burma public opinion in favour of Wild Life Protection is non-existent and until it is created little progress is likely to be made.

Periodically for the last ten years the formation of an Association or Society as an unofficial centre for fostering public opinion in favour of the conservation of the local fauna has been considered. So far nothing has materialised and since the need for such a Society is now greater than ever the sooner the matter is taken up seriously the better.

Ignorance is perhaps the greatest enemy of Wild Life Protection. Ignorance regarding wild animals and birds, their identity, habits, food and utility is general; and people do not care to protect that of which they know nothing.

A Provincial Wild Life Protection Society inaugurated by influential nature-lovers and sportsmen, and supported by educated members of all communities, could do an immense amount of good. Such a Society working in collaboration with the Society for the Preservation of the Fauna of the Empire, the Bombay Natural History Society and the Royal Society for the Protection of Birds could, by widening knowledge, evoking sympathy and promoting

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interest in the local fauna, create and foster a healthy form of public opinion.

The Society should aim at the creation of a public opinion that will demand and support amended legislation for the better protection of the fauna. It should endeavour to gain widespread support from Buddhist priests, teachers, magistrates, property-owners and agriculturists. It should organise educational efforts on the lines of lectures, publications, leaflets and answers to correspondents on questions of food, status, habits, legal protection etc., of wild animals and birds.

A Wild Life Protection Society organised and run as outlined above would give a great impetus to Wild Life Protection and the Province as a whole would benefit enormously from its achievements.

VIII. The Appointment of a Game Warden.

The recent abolition of the post of Game Warden has led to a situation that deserves serious consideration. Financial stringency was no doubt the main reason but failure to appreciate the consequences of that retrograde step was probably the chief cause of the calamity. The urgent necessity for the re-appointment of a whole-time Game Warden has already been stressed and unless action is taken at the earliest opportunity the progress made during the past six years will not be maintained and no further headway will be made with Wild Life Protection in Burma.

The protection and exploitation of the fauna is not the kind of work that can be safely decentralised unless the average executive officer realises that such work is not an optional but a compulsory duty which he must study. Centralisation of the work in a Provincial Game Warden is essential both in the interests of organisation and the education of the executive.

In 1926, in view of the increasing number of firearms and the development of the country the position with regard to Wild Life Protection became serious. A conference was held and it was decided that the appointment of a whole-time Game Warden was essential for the proper protection of the wild fauna.

In 1927 the post of Game Warden was constituted and it was held by a European Forest Officer for three years. At the end of 1931 the post was suspended but the records were maintained by a Forest Officer who was appointed Honorary Game Warden in addition to his normal duties in a Forest Division.

During the period 1926 to 1931 all matters pertaining to the protection and exploitation of the wild fauna, were centralised in the Game Warden. All protective legislation was thoroughly revised, the capture and control of wild elephants were systematised. New sanctuaries were constituted; the reservation of uncultivable land in the interests of the fauna was pushed forward. The question of developing certain sanctuaries in the direction of National Parks was considered, and a growing tendency to treat Wild Life Protection with indifference was corrected. Details of the work done are summarised in the Game Warden's Annual Reports for the years 1929, 1930, 1931 and 1932.

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At present, a Forest Officer is appointed Honorary Game Warden in addition to his primary duties as officer in charge of a Forest Division. This is of little use. The honorary appointment carries with it small power to mitigate any but the most flagrant deviations from commonsense practice and the Honorary Game Warden's forest duties leave him with little time in which to deal with protection in divisions other than his own.

IX. Revenue and Expenditure.

It is estimated that the wild fauna, excluding fish, directly or indirectly, produces revenue to the extent of at least, Rs. 1,30,000 per annum.

The sources from which this revenue is derived together with very conservative estimates of the amounts obtainable annually are given below:—

	Rs.
(1) License fees for firearms licenses for sport and for protection against wild animals ...	50,000
(2) Import duties on sporting weapons and ammunition	50,000
(3) Game and kheddah license fees	8,000
(4) Royalty on elephants captured	9,000
(5) Sale of products of wild animals	10,000
(6) Compensation and fines on account of offences against the Game Laws	3,000
Total ...	1,30,000

Trade depression and the general shortage of money may cause a considerable decrease in the revenue obtained from game and kheddah licenses and from the royalty on captured elephants, but, it is doubtful whether the revenues derived from license fees and import duties on account of sporting weapons and cartridges are similarly affected. At present there are probably not less than 20,000 sporting guns and rifles in Burma. All these weapons produce revenue directly or indirectly but although a great deal of money is being obtained from this means of destroying wild life very little is being spent on protection.

Since the Forest Department is responsible for the issue and control of game and kheddah licenses and for the enforcement of protective legislation, a fraction of the establishment charges of that department must be debited to Wild Life Protection. Beyond that, however, all the country is spending annually upon the conservation of a valuable national resource—at present a rapidly disappearing possession—is the sum of approximately Rs. 4,000 which represents the pay of the staffs in the Pidaung and Kahilu Game Sanctuaries.

The constructive proposals now put forward for placing Wild Life Protection in Burma upon a sound foundation entail an

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annual expenditure of approximately Rs. 50,000 allotted as follows:—

	Rs.
Pay and allowances of a Game Warden ...	20,000
Pay and allowances of a Game Warden's establishment	5,000
Constitution and maintenance of six sanctuaries ...	20,000
Elephant control	5,000
Total ...	50,000

This is considered to be the minimum sum with which any substantial progress with Wild Life Protection can be effected.

X. Conclusion.

Wild Life Protection in Burma is now in a critical state. Factors responsible for the present situation have been discussed and remedial measures have been proposed. Conditions were serious in 1925 but they improved between 1926 and 1931 when a Provincial Game Warden was in office. Now, things are reverting to the state they were in six years ago and prompt action is necessary to prevent irreparable damage from being done.

The lines on which action should be taken have been indicated and the chief constructive acts proposed are tabulated below:—

(1) The re-appointment of a Game Warden with the necessary establishment.

(2) The establishment of a properly co-ordinated system of Elephant Control centralised in a Game Warden.

(3) The centralisation of control of Kheddah Operations in a Game Warden.

(4) The revision of existing legislation and the replacement of the Burma Game Rules, 1927, and the Wild Birds and Animals Protection Act, 1912, by a new Wild Life Protection Act for Burma.

(5) The formation of a Wild Life Protection Society to create a Public Opinion that will demand and support amended legislation.

(6) The constitution of three new Sanctuaries, two primarily for *thamin* and one for tapir.

(7) The transference of control of all Sanctuaries to a National Trust which will develop those suitable for raising to the status of National Parks.

(8) The annual allotment of Rs. 50,000 for expenditure upon Wild Life Protection; the money to be taken from revenue derived from Wild Life Destruction.

'Wild Life Protection' does not mean the 'Artificial Protection' of 'Wild Life'. It means a fight against 'Artificial Destruction'—destruction, that is to say, which is not of Nature's ordering but brought about by ignorance, selfishness, callousness and greed. These are the factors which are destroying the Wild Life Resources of the Province, and which will, if not eliminated, cause the loss of one of Burma's most priceless possessions.

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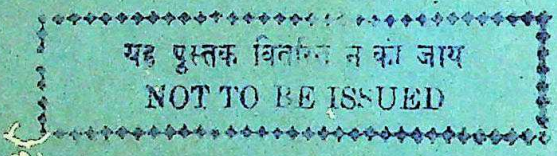

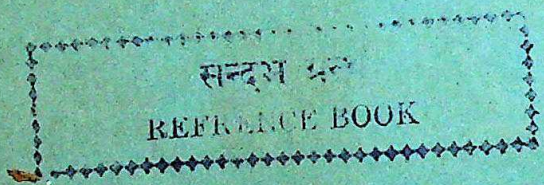

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